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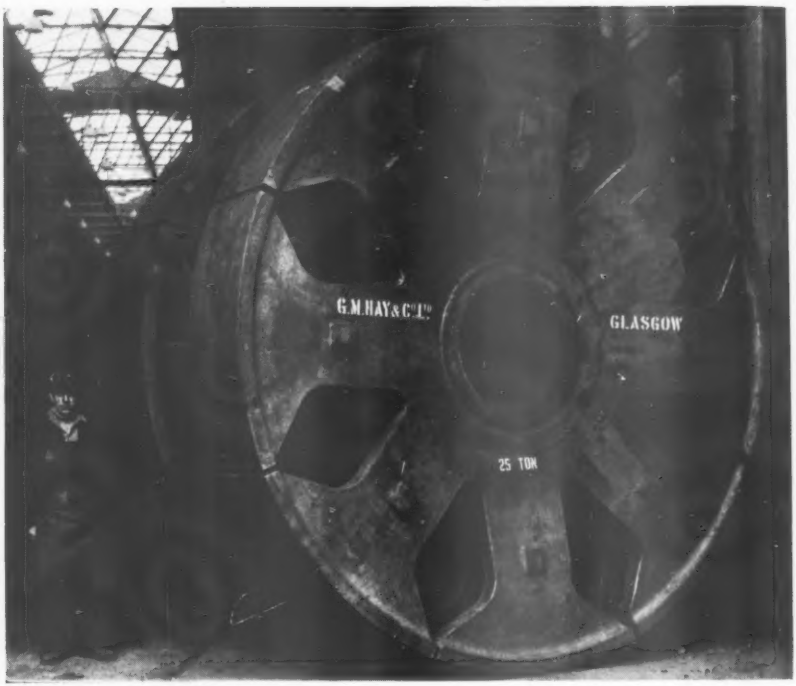


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V. C. FAULKNER, F.R.S.A., HON.M.I.B.F.

*Assistant Editor:* A. R. PARKES, M.I.B.F.
*Commercial Editor:* P. E. CARDEN.

*Advertising Manager:*
F. BARRINGTON HOOPER, B.A.

*Production Manager:*
R. J. LOVELL

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JOHN ADAM HOUSE,
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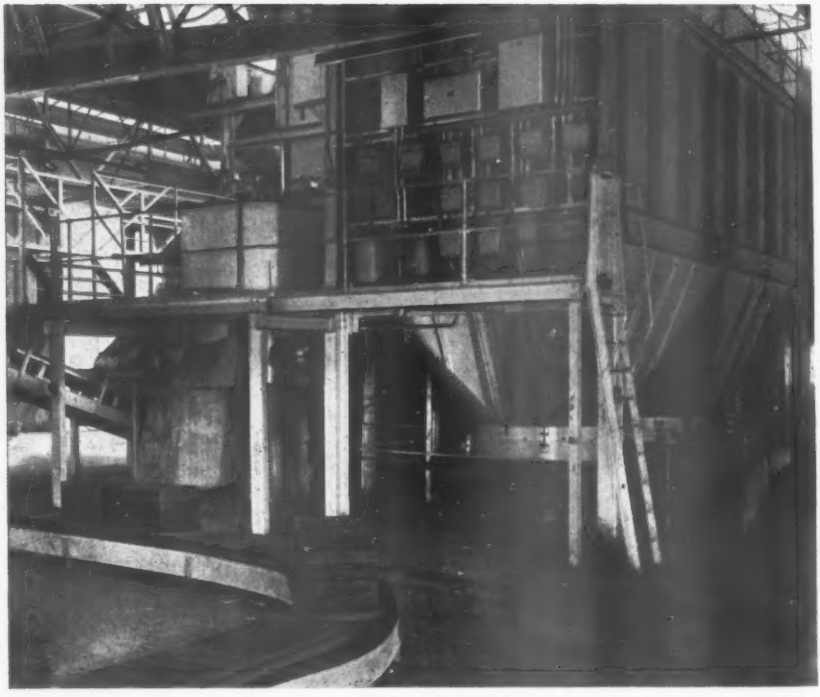

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J.J.M.

FOUNDRY
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# Progress in Technical Education

Recently, a very interesting lecture was given at the Royal Society of Arts by the Rt. Hon. Lord Nathan, P.C., on the present position of technical education in this country. In general, the lecturer was satisfied with the progress made, especially in engineering subjects. In this sphere, he said (following a visit to the Massachusetts Institute of Technology, where he had made a full inspection of the buildings and equipment) that " not only is the standard of technological education in this country in our technical colleges and universities very high, but it bears favourable comparison with and is probably higher than anywhere in the world." In some fields, however—he mentioned antibiotics as an example—we were lagging behind, whilst amongst the craft skills, the trade of glassblowing needs furthering. From an engineers' conference—European and American—the noble lecturer culled a definition of a technician, of which the following statement is but a part, " an engineering technician is one who can apply in a responsible manner proven techniques which are commonly understood by those who are experts in a branch of engineering, or those techniques specially prescribed by professional engineers." Surely this is what is known in French as an *ouvrier specialisé*, or, in plain English, a skilled workman. A list was given of some of the duties of these technicians, and all of them would fall into the simple title we have given except " sales engineering, servicing equipment and advising consumers," which occupations may or may not require skilled workmen.

Naturally, industry is keenly interested in the £100,000,000 of ratepayers' money which is currently being spent on buildings and rebuilding premises for technical-education purposes. So far as full-time day-students are concerned, attendance has risen from 39,000 in 1950-51 to 55,000 in 1955-56, and the number of part-time students during the same period has grown from 270,000 to 400,000—the population of a fair-sized city! Lord Nathan's final statement, whilst welcoming the increasing numbers, dealt with quality. " If this country can maintain the present quality of its industrial scientists, engineers and technicians, and at the same time increase their numerical strength, it will be in a favourable position to compete with the two great mass-producers of technologists—the United States and the Soviet Union," he said.

# Dinner

## FOUNDRY COKE MERCHANTS ASSOCIATION

The Foundry Coke Merchants Association held its tenth annual banquet last Thursday at the May Fair Hotel, Berkeley Street, London, W.1. The loyal toast was proposed by the chairman, Mr. Edwin Tasker, director, Darby & Company (Birmingham) Limited, and Mr. R. J. McDonald, vice-chairman of the Association proposed "The Guests" to which both Mr. F. Wilkinson, director-general of marketing, NCB, and Mr. Barrington Hooper, C.B.E., replied. In proposing the toast to the "Foundry Coke Merchants Association" Mr. H. H. Prosser (marketing officer for coke, NCB), emphasized that a great deal had been done recently to improve the quality of coke, which was now almost pure carbon (the ashes having been exported to Australia!). Mr. A. F. Beckett replied to the toast. Others at the high table included Sir Charles Fitton; Mr. A. E. Peace; Mr. J. Y. Feggetter; Mr. J. I. Willis; Mr. Arnold Carr; Mr. R. H. Thornley; Mr. C. F. Sullivan; and Mr. W. Armstrong. Cabaret entertainment was provided by Phil Burn "miming his own business," Manley and Austin and the New Vanity Fayre Company.

## Latest Foundry Statistics

*Steel Castings:* When the Iron and Steel Board collected the figures in December, there was a decrease of 150 in the number of people engaged in steel foundries as compared with a month earlier. At 18,290 the figure is 2,610 lower than a year ago. The average weekly output of steel castings in December was provisionally estimated at 3,900 tons—a very low figure. A similar comment was made in the JOURNAL about the November output, but in the latest *Bulletin* this is shown to have risen from 4,900 tons to 5,300 tons—a quite respectable figure. It is to be hoped that the 3,900 tons of December will be eventually scaled up. These estimated figures are now going back to the first 11 months of 1957—surely they should be made definite by now.

## National Society of Master Patternmakers

The National Society of Master Patternmakers announces that for those taking part in the works visit to the Dunlop Rubber Company, Limited, on March 10, arrangements have been made for luncheon, at 12 noon, at Pattison's Restaurant, 25/27, Corporation Street, Birmingham, at a cost of 12s. 6d. per head (exclusive of wines). Assembly for the tour of Fort Dunlop, commencing 2 p.m., will be at the central gate of the main entrance at the end of Holly Lane (off Tyburn Road), Erdington, Birmingham, 24; tea will be provided at 4.30 p.m., and the visit will conclude at 5.0 p.m. Members wishing to participate in the luncheon and/or the visit are requested by the secretaries, Fisher and Firkins, 12, Cherry Street, Birmingham, to obtain and return application forms not later than March 2.

THOMAS POTTER, LIMITED, Glasgow, celebrated the centenary of its establishment on February 1. During a century of development the business has remained a family concern. To-day it is directed by the third and fourth generations and it still quotes as its "bread and butter" trade the nuts and bolts it has been selling since its foundation.

# Forthcoming Events

### FEBRUARY 23

**Institution of Production Engineers**

*Manchester section:*—"Handling and Packing for Export," by D. G. S. Miller, 7.15 p.m., at Reynold's Hall, Manchester College of Science and Technology.

### FEBRUARY 24

**Incorporated Plant Engineers**

*Glasgow branch:*—"Industrial Air Conditioning," by H. Poole, 7.15 p.m., at the Scottish Building Centre, 425/427, Sauchiehall Street.

**Institution of Production Engineers**

*Shrewsbury section:*—"Employers Liability for Injury at Work," by T. Wylie, 7.30 p.m., at Walker Technical College, Oakengates.

### FEBRUARY 25

**Institute of British Foundrymen**

*Birmingham branch:*—"Introduction to Patternmaking in Plastics," by H. G. C. King, 7.15 p.m., at the James Watt Memorial Institute, Great Charles Street, Birmingham, 3.
*London branch:*—"Some Achievements of the Institute's Technical Council," by Dr. A. B. Everest, B.SC., F.I.M., 7.30 p.m., at the Constitutional Club, Northumberland Avenue, W.C.2.

**Institution of Production Engineers**

*Western section:*—"Metallic Materials Development," by S. G. E. Nash, 7.30 p.m., at the Town Hall, Weston-super-Mare.

### FEBRUARY 26

**Institute of Metals**

*Sheffield local section:*—Symposium on corrosion, 2 to 5.30 p.m., at the Engineering Lecture Theatre, The University, St. George's Square, Sheffield.

**Southampton Metallurgical Society**

"Gases in Metals," by C. E. Ransley, PH.D., F.I.M., 7.15 p.m., in the Small Physics Lecture Theatre of the University, Southampton.

**Institution of Production Engineers**

*Rochester and district graduate section:*—"New Techniques in Non-destructive Testing," by W. G. Cook, B.SC., 7.30 p.m., at the Sun Hotel, Chatham High Street.

### FEBRUARY 27

**Institute of British Foundrymen**

*Tees-side branch:*—"Cupola Experiments," by K. G. Harris, 7.30 p.m., at the Teesdale Hall, Head, Wrightson & Company, Limited, Thornaby-on-Tees.
*Falkirk section:*—"Cupola Practice," by J. Lambie, 7.30 p.m., at the Temperance Café, Lint Riggs, Falkirk.
*West Wales section:*—"Modern Developments in Cupola Operation," by R. H. Leyshon, 7 p.m., at Landore, Swansea.

**Manchester Association of Engineers**

"Electrical Models and Analogues," by Prof. E. Bradshaw, M.B.E., 6.45 p.m., at the Engineers' Club, Albert Square.

### FEBRUARY 28

**Institute of British Foundrymen**

*Wales and Monmouth branch:*—"Light-alloy Casting," by T. Williams, 6 p.m., at Newport Technical College.

## C. A. Parsons Gains US Contract

By bidding $12,100,000 (£4,300,000), C. A. Parsons & Company, Limited, Newcastle-upon-Tyne, has gained a contract from American contestants for a 500,000 kw. turbo-generator for the Colbert steam plant of the Tennessee Valley Authority.

The closest American offers came from the General Electric Company, $17,563,000 (£6,000,000), and Westinghouse Electric Corporation with $17,633,000 (£6,100,000). Both American tenders had escalator clauses. On February 11, General Electric stated that it intended to protest against the award of the contract to C. A. Parsons.

# Investment Casting in US and UK: Part I

**These first two papers reproduced in this survey of the precision investment founding industry, as reflected in the proceedings of the European Investment Casters' Association, are of a general nature. They reflect the nature and trends of activities in this sphere which have been undertaken both in Great Britain and America. In Part II, casting alloys and melting practice will be dealt with.**

## American Investment-casting Activities

*By H. P. Gray**

*In this short paper, the Author introduced to his European audience the salient features of the activities of their fraternity on the other side of the Atlantic. In this, he touched on the state of trade, the American technical institute's† set-up, "extra-mural" studies associated with universities and other bodies, and concluded with an appraisal of process adoption in his home country.*

In the USA, the investment-casting industry began about 20 years ago with the advent of cast turbine-blades, and at that time, only five or six firms used the investment-casting process. Of 5,650 foundries in the USA, there were 132 listed in 1955 as investment-casting foundries. Whilst many small, new establishments have been started, there have been many failures, and to-day the number remains about constant. The business done by US investment founders in 1957 was estimated around 125 to 150 million dollars, but it is difficult to obtain exact figures as some of the larger firms do not separate their investment-casting sales from their other sales. The rate of increase in tonnage and dollars from 1955 to 1956 was about one third; figures for 1957 are not available, but it is estimated there was no increase.

The trade recession during the last six months of 1957 marred what started out as a very promising year. The industry was hit badly by aircraft "cutbacks," but industrial applications continued to increase and will continue to develop. High labour-costs and overhead rates are a real incentive in the USA to employ investment castings as a means of reducing such costs.

A survey in 1957 of the membership of the Investment Casting Institute revealed some interesting figures, showing about 67 per cent. of dollar sales going to the aircraft industry, 13 per cent. to non-aircraft Government work, and only 20 per cent. to general industry. Sales in 1958 so far indicate that the industry is running about 20 per cent. behind 1957, with the industrial field showing a smaller drop in sales than aircraft.

Types of alloys cast in 1956, expressed as percentages of the total, were as follows: Stainless steel, 38; high-temperature types, 26; iron-base, 21; copper-base, 9, and aluminium-base, 6. The castings included in the total tonnage were: under 1 lb. 78 per cent.; 1 to 2 lb. 12; 2 to 5 lb. 6; 5 to 10 lb. 3; 10 to 20 lb. ¾, and over 20 lb. ½ per cent.

### Investment Casting Institute

The (American) Investment Casting Institute was founded five years ago, as a combination trade association and technical society. Prior to its formation, the entire investment-casting industry was clothed in an atmosphere of secrecy. It is surprising to-day how the situation has changed and what an unusual degree of co-operation exists, with a free exchange of ideas between concerns. The Institute holds two general meetings a year, with technical sessions on basic problems, covering metallurgy, alloy specifications, wax characteristics, flask containers, etc.

One of the most constructive aspects of the Institute meetings are the informal evening "bull sessions," usually held in the president's rooms. These sessions are a sort of round-table, free-for-all discussion, with a leader, where any person may bring up a production problem and ask for advice. It is the place where practical operating problems are "aired," and the judgment of members with practical experience given. The contacts gained in the committees assigned to study some of the specific problems of the industry have also helped to dispel any attitude of secrecy.

As to the accomplishments of the Institute, in addition to the very important committee work, and most notable achievement has been the publication, in 1957, of the "Investment Casting Manual." This booklet is a working manual for engineers and designers, and tells them what practical tolerances can be placed on their drawings, discussing the practical aspects of hole size, fillets, uniformity of cross-sections, surface finishes, etc. Representative case-histories of various parts are included, to stimulate the imagination of engineers and designers, and the book also includes the major metal specifications employed by US investment founders.

Another outstanding accomplishment of the Institute was the sponsoring of a seminar on investment casting at the University of Michigan in 1956, and another seminar in the summer of 1957 at Massachusetts Institute of Technology. These were intensive study-courses of one-week's duration each, covering the latest technical developments in the investment-casting industry, and were designed to interest "top" engineering and technical personnel.

* The Author is president of Gray Syracuse, Inc. of New York State.

† Proceedings of the American Investment Casting Institute were reviewed on page 186 of last week's JOURNAL.

*Investment Casting in the US and UK*

A one-day symposium on vacuum melting was also held, and the application of vacuum-melted metals for the investment-casting field was discussed. So far, the use of vacuum-melted investment-castings has been pretty much confined to aircraft and other special applications, and the number of investment casters producing components in vacuum-cast alloys is comparatively small, and restricted to the larger plants that have been substantial producers of castings and projects for defence work.

**Process Summary**

The industry is trying very hard to evaluate some of the newer techniques of casting that are somewhat in the experimental stage. There are several US licensees for the Shaw process, but in the Author's firm, little competitive pressure has been felt from this process. The Author has personal knowledge of one of the larger steel foundries in Pennsylvania which is using this process, and also of a tool-and-die shop in Massachusetts which is using the Shaw process very successfully.

The Glascast process has produced some very interesting results and some excellent castings, but the Author believes that in the manufacture of relatively small components, such as are produced by his own firm, that this process cannot compete on the question of costs with the standard investment-casting procedures.

In the USA, there is a great deal of activity along the line of the Investment "X" process, and three firms are known to have developed dip-coatings and are getting into production with this line. Their individual techniques were developed independently. Other firms are carrying out development work, and the Author states that he would not be surprised to see this general method of manufacture becoming quite prevalent. Where the methods of these three firms differ from the Investment "X" process is not known, but it is stated that what each are doing is very similar.

## Developments in Investment Precision-casting

*By A. Dunlop**

*Although investment casting, using expendable wax patterns, has been used for centuries by art founders, bell casters and jewellers, it was as recently as* 1942 *that the process, adapted to the production of small engineering components, was introduced into Great Britain from the USA. This technique, developed by Austenal Laboratories Incorporated, was based on earlier work using the lost-wax process in dental applications. Since that time, the basic technique has been developed in detail and the interest developed in precision casting has resulted in modified procedures which depart somewhat from the original method. The paper will be in two sections:—*(1) *Notes on detailed developments of the original process, and* (2) *notes on other processes,* e.g., *Investment X, Mercast, Glascast and Shaw processes.*

The original Austen process, as first practised in Britain has been described by Short[1], and by Gresham and Dunlop[2], and the following notes will deal with detailed modifications which have taken place.

**Die and Pattern Production**

Cast, low melting-point tin/bismuth alloy dies are still widely used. When very long production runs are required, steel dies made by conventional machining are often preferred. For simple shapes requiring a two-piece die, a metal-spraying technique has been developed. The master pattern is embedded into the required parting-line of the die in modelling clay and lightly coated with tallow. The half-die is then built up by spraying with copper, zinc or aluminium. When sufficient thickness has been built up, the assembly is reversed, and the clay removed. As before, the parting-line and the master pattern are lightly coated with tallow, and the second-half of the die built up by spraying. The sprayed metal is finally backed up by a low-melting-point alloy. In large dies, the final weight can be considerably reduced, thus facilitating handling, by using cast epoxy-resin backing instead of metal.

For making components of intricate shape, not requiring a high degree of accuracy, flexible dies made of rubber or polyvinyl chloride can be employed. Flexible dies are made by a process similar to that used for low-melting-point alloy dies. When rubber is used, the dies are cured by heat and pressure, adhesion between the two halves being prevented by the use of French chalk.

Wax is still the most popular material for expendable patterns. Whilst the better mechanical properties of synthetic resins, such as polystyrene, would be advantageous, for a number of reasons their use has never become widespread.

The early wax-injection machines were largely hand-operated. The assembled die was clamped manually in the machine, a warm syringe was filled with molten wax from a thermostatically-controlled reservoir, and the charged syringe placed with its nozzle in the die injection-hole and pressure applied from an air cylinder. Machines have been developed in which all these operations are applied automatically, leading to increased production and improved quality of patterns. For use with complicated dies, vacuum-injection machines[3] have been developed. In these machines, the die is evacuated prior to injecting the wax. In this way, excellent surface-finish is obtainable from complex die-shapes which would otherwise be difficult to vent.

As wax models have become larger and more complex in shape, having thin sections adjacent to thick sections, distortion troubles have greatly increased. The use of wax inserts, or chills, in the heavier sections are often employed with satisfactory results. An alternative method has been developed by Turnbull[4]. The wax is injected at a temperature of 20 deg. F. above its solidification point at a pressure of 100 lb. per sq. in.; 30 sec. after

* The Author, one of the pioneers of investment casting, is now associated with Foundry Services, Limited.

injection, the wax injector is removed and compressed air applied at 100 lb. per sq. in.; the pattern is allowed to solidify before removing the air pressure. When the pattern is large, this method is too slow, owing to the very long time taken for the wax to solidify. In such cases, it is possible to improve the cooling characteristics of the dies by circulating a coolant at low temperature through the die metal, or using a refrigerated die platten; but these improvements do not solve the difficulty created by the poor conductivity of a large volume of wax. Turnbull overcomes this by the following process. The wax is injected at a temperature of about 20 deg. F. above solidification point at a pressure of 100 lb. per sq. in.; 30 sec, after injection the wax injector is removed and compressed air applied at 100 lb. per sq. in. for 30 sec. to 2 min., when a pin is removed from the opposite side of the die. The still-liquid wax in the centre of the pattern is blown out leaving a shell pattern which is quickly cooled by air circulating through it. By making the exhaust vent smaller than the inlet, there is sufficient pressure inside the wax to press the outer wax skin closely against the die face. In this way, a hollow wax model is produced of high dimensional accuracy. A note of warning must be sounded here. Should this type of hollow pattern be used with the solid-mould technique, there may be a danger of the pressure of the investment material, during packing, distorting the pattern, that of course, does not happen when a shell-moulding method is employed.

### Pattern Investment

At the previous European Investment Casters' conference in Stratford-upon-Avon, Armitage[5] described the Pi-cast Process, in which the moulding medium, consisting of a slurry of flint with hydrolized ethyl silicate providing the binding agent, is invested directly around the wax pattern without any intermediate spray-coat or dip-coat. However, more generally, such primary coating of the wax pattern is, in fact, practised.

*Primary Investment*

To impart a smooth finish to the final mould-cavity, a fine refractory coating is applied to the wax pattern. In the original process, this was done by spraying, the following being a typical spray-coat mixture:—soap solution (1 per cent. soap flakes in water) 330 ml; sodium silicate 180 ml; dilute hydrochloric acid (10 per cent. by volume) 40 ml, and flint powder (−200 mesh) 1,120 gm.

This spraying operation required some skill, and the wax cluster had to be designed to enable the spray to be readily applied to all surfaces. When complex assemblies were required, the individual wax patterns had to be sprayed before assembly. The development of the dipping technique greatly facilitated the even application of primary investment to all surfaces of the wax assembly irrespective of its complexity. A typical dip-coating mixture[6] is as follows:—water 200 ml; glycerin 45 ml; sodium silicate 90 ml; dilute hydrochloric acid (4.4 per cent. by weight) 65 ml; 6 per cent. ammonium-alginate solution 15 ml; octyl alcohol 0.3 ml; wetting agent 7.5 ml, and flint powder 1,000 gm.

After dipping the wax assembly in the above mixture, which is kept in even suspension by stirring, and while the coating is still wet, it is sprinkled with a coarser refractory powder which provides a key, thus assisting the bond between the primary and secondary investments. As already stated, the above slurry is kept in even suspension by stirring. This settling can be prevented by the use of a colloidal suspension of silica in water, and the addition of small quantities of non-ionic surface-active agent and mineral acid. A suitable silica sol is available under the registered trade mark Syton C. Owing to their non-settling character, such slurries do not require continued stirring while in use. This type of dip-coat is thixotropic in character, which greatly assists uniform coating and draining of wax patterns. A typical dip-coat mixture of this type is as follows[7]. Syton C (15 per cent. silica content) 600 ml; Lissapol N (non-ionic surface agent) 7.5 ml; dilute hydrochloric acid (1 per cent.) up to 40 ml, and zircon (−200 mesh) 1,800 gm.

To prepare the dip-coat, the zircon and Syton are mixed together until all lumps are eliminated and a uniform mixture is obtained. At this stage, a small piece of pattern wax is dipped into the slurry and allowed to drain; the coating will be thin and not uniform. The Lissapol N is now added with stirring. Testing again with a piece of pattern wax will now show the coating to be uniform and thicker. The thickness of the coating can now be increased to the desired point by slowly adding small portions of the acid followed by testing with a piece of wax. A mixture prepared in this way is thixotropic and will not settle out. The coated wax pattern will air dry in a few hours. If desired, the coatings may be stuccoed with coarser refractory as described for the previous dip-coat.

*Secondary Investment*

This is a coarser-grained refractory slurry which, because of grain-size distribution of the refractory, it is possible to make a firm compact by vibrating. Table 1 shows typical particle-size distributions for a number of refractory fillers.

TABLE 1.—*Typical Distribution of Particles in Various Refractory Fillers.*

| B.S. sieve number. | 1. Per cent. by weight. | 2. Per cent. by weight. | 3. Per cent. by weight. |
|---|---|---|---|
| + 16 .. .. | 0.4 | 0.3 | 0.5 |
| − 16 + 30 .. .. | 18.0 | 17.0 | 21.4 |
| − 30 + 52 .. .. | 17.8 | 14.9 | 11.6 |
| − 52 + 72 .. .. | 9.6 | 7.7 | 3.2 |
| − 72 + 100 .. | 6.9 | 5.2 | 6.8 |
| − 100 + 150 .. | 7.6 | 6.0 | 23.8 |
| − 150 + 200 .. | 3.6 | 3.2 | 13.5 |
| − 200 .. .. | 36.1 | 45.7 | 19.2 |

Examples 1 and 2 above are pulverized high-alumina firebrick. The coarser material was first used, but with the need to produce castings with long slender cores, such as some types of hollow gas-turbine nozzle guide-vanes, grading 2 was devel-

oped, which produces a stronger investment. Number 3 is a proprietary mixtures of grades of refractories available under the trade name I.M.20, the chemical characteristics of which are :—$ZrO_2$, 39.6; $Al_2O_3$, 18.4, and $SiO_2$, 41.4 per cent.

This mixture, arising from a combination of particles of different size and specific gravity, gives a very dense mould after vibrating, which is again of advantage when patterns having long slender cores are to be invested.

The original bonding liquid consisted of a hydrolyzed solution of ethyl silicate. For the hydrolysis, 25 volumes of ethyl silicate, 69 volumes of methylated spirits, 4.5 volumes of water and 1.5 volumes of dilute hydrochloric acid (10 per cent. by volume) were used. When this solution was used in conjunction with the two grades of pulverized firebrick already described, 0.1 per cent. of magnesia was first thoroughly mixed with the dry refractories. The magnesia acts as a gelling agent. When this procedure is adopted the excess liquid, plus fine refractory material which separates to the top of the mould on vibrating, is discarded, because of the comparatively short gel time; this results in the loss of expensive material.

*Utilizing Recovered Liquid*

A method of utilizing the liquid recovered during vibration of the mould has been described[8]. The binding agent consists of 19.8 volumes of ethyl silicate, 78.4 volumes of methylated spirits, 1.6 volumes of water and 0.1 volume of dilute hydrochloric acid (10 per cent. by volume). No magnesia or other gelling agent is employed and the resulting slurry at room temperature has a long gel time. On vibrating, to produce a solid mould, about ¼ of the binder plus some fines are poured off, and when sufficient has been collected, an addition of refractory filler is made. For example, should enough slurry be mixed to invest say, nine moulds, the recovered liquid from these will produce enough slurry for three further moulds, and from these three moulds, enough slurry for one mould is made. The consolidated moulds are gelled by heating for about 12 hours at 45 to 50 deg. C.

*Further Development*

A further development[9] resulting in reduced investment costs has been the use of sodium silicate instead of ethyl silicate/alcohol. This binder is based upon an acidified sodium-silicate solution about 0.08N and containing about 5 per cent. of silica. It is prepared by mixing a dilute sodium-silicate solution and a dilute acid solution. Nitric, hydrochloric, sulphuric and orthophosphoric acids have all been found to be suitable. The method of preparation using hydrochloric acid is as follows:—

Sodium silicate of sp. gr. 1.3, and a $Na_2O/SiO_2$ ratio of 1:3.8 by weight, is diluted with water so that 25 ml. of this solution are equivalent to 28.0±0.1 m. of N hydrochloric acid using methyl orange as an indicator. A solution of hydrochloric acid is prepared so that 25 ml. of this solution are equivalent to 38.0±0.1 ml. of N sodium hydroxide using methyl orange as indicator. To 50 litres of this hydrochloric acid solution, 53 litres of the sodium silicate solution are added with rapid stirring. During this operation, it is essential to prevent too-rapid addition of the silicate solution to avoid gelation while mixing. This resulting liquid is the prepared binder, and 100 ml. are equivalent to 8.0 ml. ± 0.1 of N hydrochloric acid using methyl orange as indicator. A foam inhibitor may be added together with a wetting agent. This binder can be used with the refractory powders already described for use with ethyl-silicate solutions. The finished binder is low in cost and is non-inflammable, making for greater safety in operation.

While this type of acid sodium-silicate binder gives excellent results in many instances, difficulties may be encountered in moulds having long thin cores, which require an investment of greater strength. Cloherty and Emblem[10] describe a method of realizing this by modifying the binder medium with an addition of silica sol of the Syton type already referred to. Up to an eightfold increase in strength is possible by this modification.

To conclude this section on investing techniques, developments in mould vibrators will be briefly mentioned. The original vibrating tables were cam-operated at a frequency of around 300 per min., and an amplitude of about 0.007 in. Such tables have now largely been replaced by electro-magnetic tables operating at a low amplitude and a very much higher frequency. An electro-magnetic table requires less maintenance and is much quieter in operation.

## OTHER PROCESSES

As already indicated. this section will deal with other investment-moulding processes.

### Shell Moulding, using Wax Patterns

Typical of this type of mould-making are the Investment X and Glascast processes. In these, a multi-layer shell mould is formed round the wax pattern by a dipping technique. An example of this technique[11] uses a bonding agent consisting of:—34.2 per cent. (by volume) ethyl silicate, 58.2 per cent. (by volume) methylated spirits, 0.4 per cent. (by volume) hydrochloric acid (10 per cent.), and 7.2 per cent. (by volume) water.

The first coating, applied by spraying, uses a slurry of 7 oz. of zirconium-silicate powder in 100 ml. of this bonding agent. The initial coat is allowed to dry thoroughly and the shell is then produced by a multiplicity of dippings in a refractory slurry, excess of slurry being allowed to drain away after each dipping, and a stucco of coarse-grained refractory being applied. The coating after each dipping is allowed to gell before applying the next. In this way, a shell is built up to a thickness of ¼ to ½ in.

The coating material comprises 1 part by weight of silica sand and 2 parts by weight of silica flour, added in the proportion of 12½ oz. of this mixture to 100 ml. of the above bonding agent. The re-

commended grain-size distributions of these refractory powders are shown in Table 2.

TABLE 2.—*Recommended Grain-size Distribution of Refractory Powders used in Shell Moulding with Wax Patterns.*

| Sieve size. | Per cent. retained by weight. | | |
|---|---|---|---|
| | Silica sand. | Silica flour. | Stucco. |
| −30 + 40 .. .. | — | — | 10 |
| −40 + 60 .. .. | 30 | — | 25 |
| −60 + 100 .. .. | 55 | — | 20 |
| −100 + 150 .. .. | 15 | 15 | 25 |
| −150 + 200 .. .. | — | 10 | 20 |
| −200 .. .. | — | 75 | — |

When the shell has been built up to the desired thickness, the wax pattern is removed by dissolving out in trichlorethylene vapour. As with the solid type of investment moulds described in section 1, a technique of shell moulding has been developed using sodium silicate instead of ethyl silicate[12].

An initial coating is applied to the wax pattern by spraying or dipping, using any of the methods described for primary investing in section 1. Around the initial coating, after it has dried thoroughly, is formed a multi-layer shell, by dipping alternately in an acid and an alkaline solution of sodium silicate and including a finely-ground refractory material suspended in the solution. Each dipping operation is followed by the application of a stucco material to the wet mould.

A suitable acid solution is:—sodium silicate 790 ml.; water 1,450 ml.; concentrated nitric-acid 260 ml., and flint powder 10 lb. This is a 0.5 normal acid solution prepared by mixing some of the water and acid and pouring the diluted silicate slowly into the acid solution with vigorous stirring to prevent it gelling.

A suitable alkaline solution is:—sodium silicate 2,250 ml.; water 250 ml.; and flint powder 10 lb. The normality of this solution is 2.8 N alkali.

This alternating in dipping results in a rapid mutual gelling when one layer is superimposed on another. When the shell has been built up to the required thickness, the wax pattern can be removed (as previously described) using trichlorethylene vapour. Following this, the mould is placed in a suitable box and invested with dry sand, and the whole assembly fired to a temperature in the range 900 to 1,100 deg. C. This heat-treatment strengthens the mould bond, eliminates all volatile material and raises the mould to a suitable temperature for casting.

## Glascast Process

In the Glascast process, a shell mould is built up in a similar manner, the bonding agent being a colloidal dispersion of silica in water and the refractory filler a suitably-graded powder of crushed fused-silica. The most novel feature of this investment material is the use of fused silica or silica glass. The extremely low thermal-expansion of this material confers unique properties to the shell mould. For example, the wax pattern is removed by very rapid heating, the surface of the wax adjacent to the mould being quickly softened and melted before the body of the wax is heated and expands. On removal of wax from shell moulds by slowly heating, the wax expansion before melting can cause mould cracking, this is obviated in the Glascast process by the rapid rate of heating made possible by the use of a refractory of very low thermal-expansion. Problems of mould dimensional control, surface quality and spalling are reported to be minimized by using silica glass as the refractory mould filler.

### *Discussion on Shell Moulds* versus *Solid Moulds*

Shell moulds have a number of advantages over solid moulds, for example:—(*a*) The material costs are lower; (*b*) the production cycle can be much shorter; (*c*) higher mould permeability facilitates the running of thin edges and the production of fine detail, and (*d*) bad packing below horizontal surfaces with solid-mould technique can be obviated by the multi-dip method. However, it would be too much to expect one type of mould-making process to have all the advantages. When long thin cores are to be invested, the solid-mould technique may have some advantage.

## Mercast Process

The Mercast process is also a shell-moulding process in which the expendable pattern is frozen mercury. Advantages of mercury as a pattern material include the ability to join or weld component frozen pieces by light pressure, facilitating the construction of accurate complex patterns from two or more pieces. The characteristic of liquid mercury to flow readily into minute openings produces patterns having all the fine detail that may be required. The use of solid mercury permits the production of patterns of considerable size. The small volumetric change on melting out the pattern permits the use of thin-walled shell refractory moulds. The solid mercury pattern is made by filling a die at room temperature. The die must be made from material which does not amalgamate with mercury; aluminium can be used, but steel is preferred. For complicated parts or to ease die manufacture, patterns can be made in pieces and assembled by the so-called "booking" technique. To freeze the pattern, the die, filled with liquid mercury, is immersed in a mixture of solid carbon-dioxide and acetone maintained at a temperature of −80 deg. C. To facilitate handling of the frozen pattern, a handle or ring is inserted in the gate or riser prior to freezing.

### *Investing Technique*

A ceramic shell is built up around the frozen mercury by a dipping technique using a single primary coating of a fine refractory slurry, followed by a number of coatings in a coarser refractory mixture. These slurries are maintained at a temperature of −80 deg. C.

Examples of compositions used for the primary coating and outer coatings[13] are shown in Table 3.

TABLE 3.—*Compositions of the Coatings used in the Mercast Process.*

| | Primary. | Secondary. |
|---|---|---|
| Liquified monochlorodifluoromethane .. | 10,500 gm. | 28,200gm. |
| Polyvinyl acetate .. .. .. .. | 189 gm. | 798 gm. |
| Phenolic resin .. .. .. .. | 94.5 gm. | 222 gm. |
| Primary ammonium phosphate 325 mesh | 661.5 gm. | 1,200 gm. |
| Zirconium silicate 325 mesh .. .. | 17,935 gm. | 35,928 gm. |
| Aluminium silicate − 14 + 35 mesh .. | — | 21,852 gm. |

The pattern is given one coating of the primary investment and the solvent allowed to evaporate, while the assembly is hung in a refrigerated tank at − 80 deg. C. This is followed by a number of dips in the secondary investment slurry; again between each dip the solvent is allowed to evaporate. In this way a layer about ¼-in. thick is built up. Melting out the mercury pattern is accomplished by directing a stream of mercury at room temperature against the frozen pattern. This starts the melting, and the shells are left for a few hours in the inverted position over a collecting table to allow the last dregs of mercury to run out; all the mercury is recovered and re-used.

The ceramic shells in the "green" state are charged directly into a furnace running at 1,000 to 1,050 deg. C., and fired for about 2 hours. This heat-treatment removes the volatile, low-temperature organic binders, the bonding of the ceramic shell now being effected at the higher temperature by the ammonium phosphate.

Since the thin ceramic shell is fairly permeable, it is possible to employ a vacuum-casting procedure to the mould. This is effected by putting the mould in a metal box containing a loosely-packed material, such as steel shot or coarse sand, and then applying a layer of ceramic cement to the top of the box to form an airtight seal around the runner sprue. The bottom of the box is connected to a vacuum chamber whereby suction is exerted on the mould. This procedure permits of the casting of thin sections without having to preheat the mould, which is very beneficial in the control of the grain size of the casting. Claims made for the Mercast process include the ability to produce moulds of larger size, a high degree of surface finish and accuracy, and the production of intricate shapes.

### Investment Casting without an Expendable Pattern

An example of this type of precision-casting technique, which has become very widely used in the last few years, is the Shaw process. The Shaw process differs fundamentally from the processes already discussed in that no wax or expendable patterns are employed, and accurate moulds are produced directly from suitable master patterns. Thus, complications associated with wax-moulding dies and wax-injection equipment are avoided, and dimensional errors arising from wax shrinkage and distortion eliminated. A further advantage of this process is the wide range of casting size which can be handled, ranging from a few ounces to over 700 lb. Technically there is no upper limit to the size of casting possible.

The process has been described in detail.[14, 15, 16, 17] The first step is to make a master pattern, preferably in brass, bronze, steel or plaster, of the part required. Wood can be used successfully for the pattern, but it should be borne in mind that the final casting produced can be of no greater accuracy or surface finish than the pattern used. The pattern incorporates the necessary allowance for metal shrinkage only, the final mould cavity being exactly the same size as the pattern. To ensure maximum accuracy, the pattern is not split as in normal sand practice. The pattern is invested one section at a time with non-refractory liquid setting-material of the plaster-of-Paris type. Each of these plaster sections is replaced in turn by a refractory mouldable material.

The accuracy and good surface-finish obtained in castings made by this process is largely due to the unusual properties of the mould material. The mould material is prepared in the form of a slurry by mixing a suitably-graded refractory filler with a colloidal suspension of silica in alcohol, to which a reagent has been added to produce a controlled gelling reaction. A partially-hydrolyzed solution of ethyl silicate is used, and the gelling reaction, after admixture with the refractory filler to form a pourable slurry, varies from about 1 min. to 5 to 10 min. depending on the size of the mould being made, the actual time being under the control of the operator.

As the gelling process progresses, the mould slurry solidifies, passing through a tough, rubbery-like phase. The mould is stripped from the pattern while in the rubbery condition, making possible the use of patterns with no draw, and in some cases even a slight undercut. Mould pieces in the rubber-like condition are rapidly fired by igniting the alcohol present. After firing, the mould sections and cores, where cores are necessary, can be inspected before assembly. The assembled mould, suitably clamped, is then cemented together by pouring around it a thick quick-setting refractory slurry. Again the cementing material is fired by igniting the inflammable constituent of the binder liquid. The now essentially one-piece mould can be cast at room temperature, or if the alloy or casting shape warrants it the mould may be heated to temperatures up to 1,050 deg. C. The main advantage of this type of mould-making is that it greatly extends the possible range size of castings having good accuracy and surface finish.

This now concludes the review of some of the developments which have taken place in precision-investment moulding techniques over the past 15 years or so, in which the Author has been directly or indirectly connected, and the paper will be concluded with some notes on melting and casting which are common to all the processes discussed.

### Melting and Casting

Since the inception of lost-wax investment casting as applied to small engineering components, the small indirect-arc furnace pioneered by Merrick[18] has been extensively used. Originally these furnaces were of around 3-lb. metal capacity, and the moulds, prior to pouring by inverting the furnace, were

fixed to the unit by a hand-operated screw clamp. The main development has been in increasing the capacity of such furnaces, the popular size now holding around 15 to 20 lb. of metal. Air-operated mould clamps have been developed and automatic rocking-gear introduced. Water-cooled electrode clamps are used on the larger furnaces along with screw-operated control gear.

High-frequency melting equipment is also widely used moulds being either gravity-poured or pressure-cast. The latter method is effected by clamping the mould to the top of the melting unit and inverting the whole assembly as with the small arc furnace, air pressure being applied behind the metal as it enters the mould. Centrifugal casting such as described by Armitage[5], is also employed.

Reference has already been made when discussing the Mercast process to the application of a vacuum to the mould to assist the running of fine detail when using cold moulds. The use of vacuum processes have been extended in two directions:—(1) The use of vacuum-melted and cast alloy stock for remelting in air or inert gas in the indirect-arc furnace, and (2) the complete process of melting and casting the investment mould *in vacuo*. These vacuum processes are not yet being widely used, but they enable higher quality to be obtained from existing alloys, and allow new alloys, containing fairly large quantities of reactive metals such as aluminium, titanium or zirconium, to be produced.

An example of the improvement in properties arising from vacuum-melting and casting alloy G34[19] (Jessop's alloy), a cobalt-base alloy containing:—carbon 0.8; manganese 0.8; silicon 0.5; cobalt 45; nickel 12; chromium 20; molybdenum 2.0; vanadium 2.8, and niobium 1.2 per cent., is as follows:—ductility increased from 2½ to 9½ per cent.; creep strength increased 15 per cent., and fatigue strength increased 20 per cent.

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# News About Canals

## Midlands Re-organization

British Waterways have placed a contract with Sir Alfred McAlpine & Son, Limited, Wolverhampton, for the construction of new engineering workshops at Bradley (near Tipton, Staffs), on the Birmingham Canal Navigations. The workshops will undertake the whole of the maintenance, repair and construction work in the Midland District of British Waterways' South Western Division. They will replace the present isolated and obsolete Ocker Hill Repair Yard which, together with certain short lengths of connecting canal, has been sold to the Tipton Corporation, who plan to redevelop the area.

The buildings at Bradley, which will occupy an area of some 17,000 sq. ft., will be steel framed with asbestos-sheet roofing and with brickwork sides and ends; a two-storey office block will be incorporated. Equipment will include an overhead gantry, two covered dry-docks (one fitted with a boat manipulator for upturning boats in course of repair), a blacksmiths' hearth, petrol and diesel-fuel installations, steel binning, etc. Also, such equipment as is still suitable will be transferred from Ocker Hill.

The canal lengths to be disposed of comprise about 2½ miles already statutorily closed by Parliament, but which have been kept open and maintained to provide access to the Ocker Hill Repair Yard. They have required constant inspection to eliminate the risk of breach, and will now be drained and sealed off prior to their transfer to Tipton Corporation. By arrangement with the British Transport Commission's curator, the historic James Watt beam-engine, which for some years has been preserved at Ocker Hill, will be transferred to the Birmingham Museum of Science and Industry.

## Telford Aqueduct

Concern felt for the safety of the iron balustrade protecting the footpath alongside the 154-year-old aqueduct at Trevor, North Wales, brings this engineering feat of a century-and-a-half ago into the news once again. The first open-caisson aqueduct to be built, it carries the Ellesmere Canal 127 ft. above the Dee Valley near Llangollen. At the time, Telford himself described the project of linking Mersey, Dee and Severn as "the greatest work now in hand in the kingdom." The biggest single problem of the project was carrying the canal over the valley between Trevor and Froncysyllte, where the Dee was 127 ft. below the water-level of the canal. The first intentions were to "lock" the water—and boats—across—but this, involving a dozen or so locks, would have been too costly; if an aqueduct were decided upon, it was clear that the great height at which it was necessary to work would entail a new method of construction.

In actual fact, the latter course was followed, applying Telford's revolutionary proposal to build an aqueduct of cast iron. A foundry was set up on the spot to cast the sections of the "trough," while the masonry piers, rising 121 ft. above the river, were being built from stone quarried nearby. The aqueduct, which cost £47,018, was opened by that great canal pioneer, the Earl of Bridgewater, on November 25, 1805.

The present cause of the concern felt by the Denbighshire County Council, on which they will report shortly to the Transport Commission, is the condition, not of the aqueduct castings themselves, but of the protective balustrade along the towpath—a necessary precaution at such a height above the valley.

## Trends in Machine-tool Trade

Slight improvement in home orders for machine tools during October was not maintained in November, a drop from £3,540,000 to £3,180,000 being recorded.

Export orders, given a sharp boost by a contract worth £1,000,000 placed by China in November, rose from £1,480,000 to £2,460,000. As a result total orders for the month rose by 12 per cent. to £5,640,000, exceeding total deliveries for the first time since August, 1956. A continuation of the favourable trend is not expected for subsequent months.

On the delivery side in November there was a fall of £87,000 in the value of machine tools for the home market, while export deliveries fell by £110,000, and though total deliveries were exceeded by orders, this did not prevent the cumulative order-book from shrinking once again. At £57,880,000 the end-November figure was £22,000,000 below 1957.

Some improvement is hoped for from the recent trade mission to Spain by the Machine Tool Trades Association, the Leipzig Fair next month and the attempts being made to rebuild trade with eastern Europe.

Home orders for machine tools may also be assisted in the future if the Board of Trade allows last month's application for a 10 per cent. duty on all machine-tool imports in place of the present 17½ per cent. with concessions when no suitable UK product is readily available.

## S & L Profits Fall

Possibility of a further fall in profits of Stewarts and Lloyds, Limited, in 1959 was referred to by Mr. A. G. Stewart, the chairman, at last week's annual meeting of the company in Glasgow.

Despatches of steel tubes and pipes to the oil industry in the first quarter of the current financial year were more than 50 per cent. below the level of a year earlier, he said. Despatches of those products to other customers were slightly higher, but demand from the oil companies showed no sign of recovering from the very low level. Deliveries of Stanton products were also somewhat lower than in the first three months of 1958.

As far as the company's prospects beyond the immediate future were concerned, Mr. Stewart said that in the long run the board was satisfied that the capacity which had been created and was still being created would be fully required.

On steel nationalization, he said there was an overwhelming case against it, and this was becoming increasingly appreciated. The threat of nationalization was of concern to shareholders, the industry, and the nation. "So long as the threat hangs over us it is our duty to defend ourselves," said Mr. Stewart.

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FLEXICON, LIMITED, belting manufacturers, North Wing Mills, Bradford, recently opened new offices and stock rooms at 72, Vicar Lane, Bradford.

## Long-service Presentations

*Ball Brothers (Engineers), Limited, Reliance Works, Stratford-on-Avon, have presented gold watches to four of their employees, for long and meritorious service to the company. The illustration shows the four men being congratulated at the presentation ceremony by the managing director, Mr. F. V. Ball. They are, left to right, Mr. A. Brown (blacksmith, 43 years' service); Mr. A. Goode (coremaker, 57 years); Mr. A. E. Padbury (foreman patternmaker, 40 years), and Mr. L. Waters (chargehand moulder, 44 years' service).*

# Comparison of Standard and Tilting, Rotary Furnaces

Owing to a certain similarity in name and general appearance, the standard rotary melting furnace is occasionally confused with the tilting rotary. It is announced that the makers of the former type, the Monometer Manufacturing Company, Limited, have recently acquired the manufacturing rights of the Stein & Atkinson tilting rotary, so it is now possible to make an unbiased examination of both types. Both are expressly designed for bulk melting.

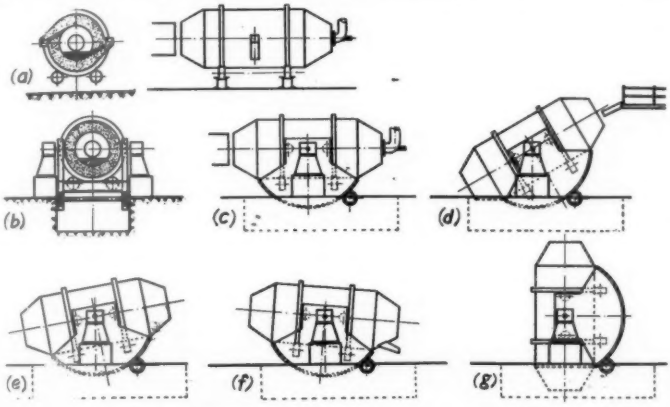



FIG. 1. (*a*) to (*g*).—*Fig.* (*a*) *shows the standard rotary furnace, and* (*b*) *the tilting rotary furnace. In Figs.* (*c*) *to* (*g*) *the tilting furnace is shown in various positions, as follows:—*(*c*) *melting;* (*d*) *charging;* (*e*) *slagging;* (*f*) *pouring, and* (*g*) *re-lining.*

### Standard Rotary Furnace

The standard rotary furnace, as will be seen from Fig. 1 (*a*), is essentially a cylindrical shell, lined with refractory, and fired by a burner at one end. It is rotated on rollers during the melting period, and tapped from a spout which may be situated either in the middle, or mounted on the conical end of the furnace body. The rotation of the furnace during mixing and melting is one of the reasons for its low fuel consumption, as the metal is melted not only by flame radiation over and through the charge, but also by contact with the heated refractory lining of the revolving furnace. Rotary action also prolongs the life of the lining, which is cooled by contact with the charge, thus avoiding overheating of the lining. The furnace construction makes it easy to discharge the metal into an efficient form of recuperator, which is particularly necessary when melting irons or steels.

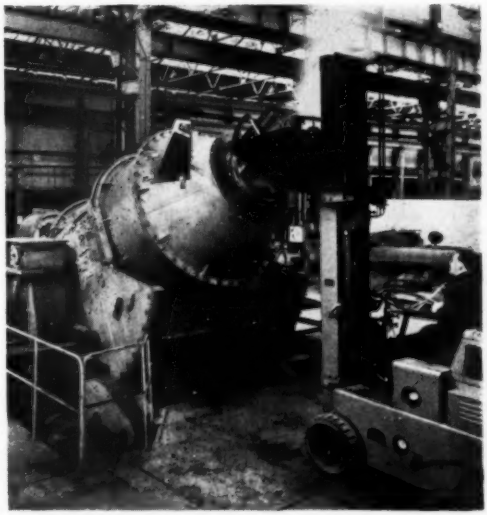
### Tilting Furnace

The tilting rotary type consists of a somewhat similar cylindrical shell which rotates on rollers during melting. It is likewise easy to pour the molten charge into a recuperator. However, in the case of tilting furnace the cylindrical shell, rollers, and rotating gear are carried in a cradle with a quadrant gear, this cradle being supported at each side (Fig. 1b). This allows the furnace to be tilted axially to the required angle as shown in Figs. 1 (*c*) to 1 (*g*). In Fig. 1 (*c*) the furnace is shown in position during melting; Fig. 1 (*d*) shows the position for charging, either from an overhead platform, hopper and chute, or mechanical charging-truck; Fig. 1 (*e*) demonstrates the slagging position, and Fig. 1 (*f*) the normal pouring position, although pouring can be effected from the other end of the furnace if required. Pouring spouts are normally fitted at the conical ends, with only a small movement of the spout necessary between the start and finish of the pour, and the furnace may be tilted vertically (Fig. 1 (*g*)) for relining, either by ramming or bricking.

*Advantages*

The advantages of the end-tilting furnace are purely mechanical, there being no difference in the melting efficiency of the two types, either of which is suitable for refining copper, or

FIG. 2.—*Charging a tilting rotary furnace from a mechanical lifting-truck.*



*Comparison of Rotary Furnaces*

melting malleable and high-duty irons, etc. The main advantages of the tilting type may be summarized as:—(1) Ease of loading; (2) relining of the shell can be effected without removing it from its position; (3) easy disposal of slag, and (4) low fuel costs.

Several types of fuel may be used in either furnace, the most popular being fuel oil or creosote-pitch. Gaseous fuels are equally economical.

# Separation of Blast-furnace Slag

## A Process of Interest to Ironfounders

Blast-furnace slag is one of the steel industry's biggest by-products; nearly as much slag as iron is tapped from the blast furnace, and the quantity of slag produced annually by British ironworks amounts to the formidable total of more than 10,500,000 tons. Whether it is used or dumped, this vast tonnage has to be removed. Slag is really a synthetic mineral, and for many purposes it can replace natural stone. The advantages of using slag in this way are various; the national economy benefits, and the landscape is spared the extension of slag-heaps and quarries—a two-fold gain.

Nevertheless, about half the slag made in this country is tipped to waste. There are various reasons for this failure to make use of a potential raw material: in some areas transport costs make slag more expensive than easily-accessible natural rocks; and sometimes the slag itself is judged unsuitable on technical grounds. Clearly it is mainly in technical problems associated with the quality of slag that research can help. The defect that gives most trouble is execessive porosity, and it is here that the slag separator* developed by the British Iron and Steel Research Association's chemistry department may prove useful.

### Slag porosity

Molten slag does not effervesce until it is tapped from the furnace; bubbles that form then are subsequently preserved when the slag cools and solidifies. Although there are large potential markets for highly-porous, or "foamed" slags, by far the greater demand at present is for dense slag for road-making, aerodrome runways, and railway ballast. In these applications some degree of porosity is necessary, as it confers excellent anti-skid properties and holds tar or bitumen coatings well. On the other hand, if the slag is excessively porous it will absorb too much tar or bitumen both during and after the application of the coating, and may even prevent the product from meeting the BSI specification, which requires a bulk density of 78 lb. per cub. ft.

### Slag Production Methods

Dense slag can be obtained in two ways. One is to allow the molten slag to cool and solidify in the ladles used to transport it from the blast furnace.† This method provides a very good product, but it puts too many expensive ladles out of use while the slag is cooling. The second method is to empty the slag out of the ladles into pits or on to banks, and allow it to cool and solidify before excavating and processing it. It is this method which is more generally used; it is obviously cheaper than the first, but the porosity of the slag produced is rather variable.

### Porosity Control

The problem of controlling the porosity of slags can be approached in two ways; attempts can be made to regulate the number of bubbles trapped in the cooling and solidifying slag, or the porous material can be separated physically from the dense material after the slag has solidified. Both these approaches are being investigated by BISRA, but the first is not described here.

When research began it was known that there was no significant chemical difference between dense and porous slag from the same ladle. A separation process would therefore have to depend on the physical properties of the slag particles. Moreover, because even dense slag does not command high prices, the method used for separating the slag must be as cheap as possible. There was no commercial method in existence for materials of the range of densities covered by blast-furnace slags, and in any case the flotation processes generally used in mineral-dressing are comparatively expensive in both capital equipment and running cost.

### BISRA Slag Separator

The BISRA slag separator, devised to provide a cheap and simple method, makes use of the winnowing action of an air-stream. The air-cooled slag is first crushed and graded fairly closely to size. The crushed slag is allowed to fall under gravity through a transverse air-stream. The particles are blow sideways, the lighter and more porous ones further than the heavier (denser) ones, which have greater inertia. An upright blade placed in the path of the fan-shaped stream of falling slag particles serves to direct the lighter and denser fractions into separate hoppers. The amount of separation depends, of course, on the distribution of bulk density in the slag; this can be easily determined in a laboratory separator. The equipment is portable and has few working parts that need to be maintained or replaced.

* The subject of Patent Application No. 23104/57.

† Foundry cupola slag has been treated in this way by one large ironfoundry in the Midlands. The product was reputed to be so good that contractors smashed up the lumps and took it away free of cost.

For further information about the slag separator write to the Information Officer, BISRA, 11, Park Lane, London, W.1.

**Dunswart Works Visit.** *Last October, a party of members and guests of the South African branch of the IBF visited the works of Dunswart Iron & Steel Works, Limited, in Benoni, South Africa. The illustrations show a party of visitors (a) having a look at the drag mould of a copper convector, and (b) watching the same mould being closed. A full account of the visit appeared in the feature "Notes from the Branches," on page 780 of the December 25, 1958, issue of the* JOURNAL.

# American Letter

## Quenching Oils*

Foundries not previously engaged in the quenching type of heat-treatment will find that the quality-control standards for the heat treatment of wrought-steel parts have become more rigid in recent years, and will be equally rigid for castings. The increasing importance of, and variables affecting, the quenching phase of heat-treating steels is discussed below.

*Agitation*

Since oil is the most versatile quenching medium, considerable investigation and development has been done in recent years to further increase its quenching power, operating temperature range, and stability for long service. Agitation of a quenching medium is important, regardless of which medium is being used, because violent agitation, produced either by high-capacity pumps, or propellers, can greatly increase the cooling power of any medium if properly directed. This is especially important when using fast-quenching oils.

*Additives*

One additive for quenching oil which is cited by the author, has the ability, when added in the proper ratio to selected quenching oils, to approximately double the cooling power of oil in the 843 to 371 deg. C. range. Also, a fast, additive-type quenching oil, operating in an oil-temperature range of 93 to 149 deg. C. with adequate agitation, has improved quality control beyond any point that has previously been attained.

*Summary*

The benefits to be obtained by the adoption of a more efficient quenching oil, and good quenching techniques, may be summarized as follows:—

(1) Economical service lift of the quenching medium; (2) uniform hardness pattern; (3) elimination of undesirable transformation structures; (4) development of optimum quenching conditions for steels of small or varying grain sizes, different hardenabilities, and variable cross-sections; (5) minimum dimensional changes, and (6) elimination of quenching cracks.

## Non-destructive Testing by Radiation†

The general problems concerning non-destructive testing by radiation are discussed under the following headings:—(1) Choice of source or unit; (2) exposure-room design; (3) protective materials; (4) fixed and portable sources, and (5) employee considerations. The three testing units described are the 250 kv. X-ray, the 1,000 or 2,000 kv. X-ray, and the 1, 2 and 24 million-volt betatron. The choice of unit depends on the kind of metal, the metal thickness, and the amount of work to be performed in a given period of time.

*Design*

Considerable thought should be given to the design of the layout, for mistakes are expensive to rectify. A compact exposure room will be less expensive to build, but insufficient room may necessitate rebuilding at a later date. An L-shaped room can save a lot of expense on door protection. Frequently, the building design includes a protective passageway between the radiation room and the control room.

*Protective Materials*

The most common protective materials for the radiation room are lead, steel and concrete. One in. of lead is equivalent to approximately 4 in. of steel or 12 in. of concrete. Combinations of these materials may be used to advantage. For protection when using the million and two million-volts X-ray and the betatron, 18- to 72-in. concrete walls are used. By using steel or lead sheets as inserts or linings, the wall thickness may be reduced. It is a good thing if the building is isolated, preferably in a fenced enclosure, because then only the operating personnel need protection. Periodic medical tests should be made to maintain a record of the operators' physical condition.

## Motor-boat Industry

The National Motor Boat Show, which lasted for ten days, ended in New York on January 25. The motor-boat industry, in which aluminium is being increasingly used, is booming. It is estimated that 23,500 tons of aluminium was used in boat and outboard-motor manufacture during 1958. About 8,500 tons were used for boats, an increase of about 13 per cent. on the 1957 total, and about 15,000 tons for the motors, which was about the same as that for 1957. The number of recreational craft plying the US waterways now amounts to approximately 7,330,000.

Of these, 481,000 are motor boats required to register with the Coast Guard, about 314,000 are unnumbered inboard-motor boats, and 3,620,000 have outboard-motors. During 1958 inboard-motor production amounted to 24,500 units, of which 3,500 were diesel, and the remaining 21,000 gasoline, motors. 545,000 new units were sold in 1958.

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# OEEC Lead, Zinc Output

Total pig-lead (minimum content 99.95 per cent.) production in OEEC producer-countries (Austria, Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, the United Kingdom, and Sweden), as well as in Morocco and Tunisia, amounted to 59,569 *tonnes* in December, 1958, compared with 55,812 *tonnes* in the previous month. Compared with December, 1957, there was an increase of about 15 per cent. in production.

Refined-zinc production for OEEC producer-countries (Austria, Belgium and the Belgian Congo, France, Germany, Italy, the Netherlands, Norway, and the United Kingdom) totalled 71,588 *tonnes* in December, 1958, against 67,566 *tonnes* in November. Compared with December, 1957, production decreased by about 3 per cent.

The December, 1958, breakdown into qualities was:—High-grade and special high-grade zinc (at least 99.95 per cent. zinc content), 27,751 *tonnes*; others (g.o.b., debased), 43,837 *tonnes*.

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## British Batteries for Indian Steelworks

Large orders for battery equipment have been received by Nife Batteries, Limited, Redditch, for switchgear duties and emergency lighting at the £100,000,000 steelworks which is being constructed by the Indian Steelworks Construction Company, Limited, a consortium of British manufacturers, at Durgapur, West Bengal.

The equipment, the cost of which is about £30,000, has been specially designed for use in the tropics and all the batteries supplied will be 110 v.

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* Extracted from an article written by N. F. Squire, vice-president of Aldridge Industrial Oils, Incorporated, Cleveland, Ohio.

† This article is a synopsis of a paper which is to be presented at the AFS meeting in Chicago in April. The author is F. S. Sutherland, plant metallurgist of the continental foundry and machine division of Blaw-Knox Company, East Chicago, Indiana.

# What Apprentices should Know and Do

**In an address to the apprentices of John Harper & Company, Limited, Mr. H. G. Hall, F.I.M., F.R.S.A. (a director of Castings, Limited, of Walsall), recapitulated a few well-known facts about the foundry industry in general, and disclosed information designed to make the work of the youngster in the foundry more interesting. In what follows an extract has been made of the major points of his address.**

The ironfoundry industry produced some four million tons of iron castings in 1956, compared with 21 million ingot tons of steel. Now the steel industry is widely acknowledged to be the sheet anchor of the national economy, and when it is realized that castings output is nearly one-fifth of that of steel one begins to appreciate the importance of the ironfoundry industry. This is further emphasized by the fact that 46 per cent. of Britain's total exports in 1956 were metal and engineering products, which in themselves used approximately two-thirds of the whole of the iron castings output. Ironfounding is thus a vital and basic industry, and it may well be asked why it is that it is so rarely in the news or in the public eye. The significant answer is that the structure of the industry is so complex. To-day there are about 1,750 ironfoundries in the UK producing an infinite variety of castings, from one ounce to 150 tons each in weight, but of these foundries over 60 per cent. employ 50 people or less, and 63 major foundries produce over half the total output. The boys that Mr. Hall addressed were employed by one of these 63 major foundries.

Nevertheless it is perhaps the industry's greatest weakness that so many foundries employ so few people, because it is difficult for the industry to unite and so obtain the strong leadership which it undoubtedly deserves. However, the Council of Ironfoundry Associations is now becoming sufficiently powerful to make its influence felt in government circles.

### BCIRA Research

This industry is strong in matters of research through the British Cast Iron Research Association, which has made notable contributions to the metallurgy of cast iron and methods of production, and which is certainly the envy of European neighbours and much admired in America. The quality of work emanating from the BCIRA is second to none in the world, but the application of this research in the foundries is not sufficiently widespread. Far too often other countries excel in using and applying the results of British research work, and this is where the apprentices of to-day can help. More technicians must be trained for the foundry industry, to help translate the findings of the research people into workable, practicable, foundry techniques and processes.

### Modernization and Improvement

Dealing further with the strength of the industry, there is no reason why, given reasonable trading conditions generally, it should not continue to expand. There are, and always will be, threats of replacement of iron castings by various alternative materials, but wherever these threats have been successful the ironfoundry industry has always found another outlet for its products, and will continue to do so as long as management continues to modernize its foundries, and to improve its product. From the angle of modernization, this country has foundries which compare favourably with the best in the world, Harper's being one of them.

As far as improving the product is concerned, most people are aware that both Meehanite, and the latest development in cast iron, nodular or spheroidal-graphite cast-iron, are being produced in British foundries with a very high degree of technical control. There are also hot-blast cupolas and the $CO_2$ Process of producing moulds and cores, which show how complicated the life of a foundryman can be. This life is never boring, however.

### A Trip Round the Foundry

A short tour of the foundry can reveal much of interest if " text-book " spectacles are discarded for a few minutes. The iron is melted in a cupola at Harper's—but how many people realize that it takes 300 tons of air every week to burn the coke used, or that, depending on atmospheric conditions, the weight or volume of this air varies by plus or minus 7 per cent. How many people appreciate that some of the nitrogen released in this process of combustion goes into the iron and makes it harder and stronger—or that Harper's lose over 300 tons of iron a year by oxidation in this combustion process.

How many chemists look at a ladle of molten metal and think of the silicon or carbon content instead of say, the amount of iron silicide and graphite or iron-carbide content? How many realize the profound effect that impurities such as lead, tin, arsenic, etc., can have even when present in only a few parts per million in the final product, or that if one could extract the hydrogen content it would occupy as big a volume as the piece from which it is extracted? How many moulders realize that if they all decided to use a downgate say $\frac{1}{8}$ in. larger in diameter, the cupolas would have to melt several tons more iron per week for the same output—or that a casting made with a lot of coal-dust in the sand is dimensionally smaller than it would be if there were no coal-dust in it at all? Another interesting point is that a casting made in a dry-sand mould not only chills quicker, but is dimensionally more accurate, than if made in a green-sand mould —or that atmospheric pressure is so strong that,

*What Apprentices should Know and Do*

if, due to a local hot spot in the mould, the skin of the casting is torn or punctured when the molten metal is cooling, the pressure through the puncture will stop the feeder from working and result in an unsound casting?

**Qualifications for Success**

What are the qualifications which will enable present-day apprentices to grasp their opportunities and rise to the top? They are: (1) Commonsense, (2) enthusiasm for the job, and (3) the ability to think for oneself. These qualifications will now be examined more closely:

*Commonsense.* The need for the right type of youth for future management positions has already been stressed, and, given reasonable ability, there is so little competition that boys must make progress more quickly than in almost any other industry. Many grammar school boys would do better in the foundry industry than in the newer and superficially more attractive industries such as nuclear fission, electronics, etc., where the competition must be very keen.

*Enthusiasm for the Job.* No one can expect to succeed in a job which bores him, or is beneath his dignity, or which gives him no pride of achievement.

*The Ability to Think for Oneself.* This is the most important qualification. One cannot turn the clock back, and there are many aspects of the present welfare state which are excellent. But the overall policy of free milk at school; provision of meals and transport; the gift of a free day a week at technical school in the early stages of a career, and the health service pension schemes, etc., all encourage the belief that it is someone else's duty to look after one—to provide one with a job, and to pay one well for doing it. In other words it encourages youths to believe that if they merely do what they are told, some one else will do the necessary thinking. What nonsense! Boys must think for themselves if they want to get on. The lecturer has interviewed far too many young people who appear to have a reasonable knowledge of the job they do, but who do not know why they do certain things, or the importance of their job in relation to the final product, and who are completely blind as to the things going on all around them. The young person must keep his eyes open, and ask questions. If the answer doesn't seem to fit, he must not accept it blindly, but ask again. If, during his apprenticeship, a youth is faced with a difficult task or problem, he must try to solve it himself before taking it to the foreman or manager. It is true that these people are paid to help, but they cannot do their job properly if they have to do everybody else's thinking as well. In the long run, under such conditions, the management cannot do its real job of being efficient enough to keep the workers fully employed, so the youth himself suffers. "Help yourself by helping others is not a bad motto."

## New Catalogues

**Resins, Resin-coating Equipment and Resin-coated Sands.** All users of the shell-moulding and -coremaking processes will be interested in a new catalogue recently issued by the Fordath Engineering Company, Limited, Brandon Way, West Bromwich. It deals with three separate activities. For the first—that is, the provision of liquid phenolic resins—a new shop has been built and equipped at the West Bromwich works, and in it there is a modern manufacturing plant. A full description is given of the resins, including handling and properties for mixing in the actual foundries. The second part of the catalogue deals with pre-coated resin/sands and the extensive plant which has been installed for their manufacture. The product, known as Plastsand, is made on machinery which is completely automatic, even to bagging and weighing. The brochure describes a sensible system of annotation adopted by the company, which tells the user the nature of the base sand, and the percentage and grade of resin which has been incorporated. The third section deals with the supply of plant for foundries wishing to make their own pre-coated sand. This is available in three sizes and the design is based on the extensive experience gained by the company in its own works. The brochure, which runs to 20 pages, has been interestingly written and well illustrated.

**Tools and Supplies.** A general catalogue has recently been issued by Buck and Hickman, Limited, of 2, Whitechapel Road, London, E.1, and elsewhere. Although it is designated the 1958 edition, it must be made clear at the outset that such a catalogue is only issued at five-year intervals—indeed, such is its comprehensive nature that more-frequent publication would be impossible. This voluminous catalogue, which runs to over 1,275 pages, is outstanding amongst trade publications and is eagerly sought after by purchasing officers. It is generously illustrated and contains about 20 pages of very useful formulæ and tables. The book is splendidly and carefully indexed—this section alone occupying 60 pages, each of three columns in small type. Obviously, the production of a priced catalogue of such dimensions denotes that it has a very wide coverage of engineers' supplies and, to withstand long and continuous use, the binding is strong and well-finished. The catalogue is a valuable asset in the office of any buyer of engineering tools and supplies.

**Protective Coating.** A four-page illustrated leaflet received from C. & P. Development Company (London), Limited, Wiggie Works, Redhill, Surrey, deals with Rust-Anode. This is a surfacing material applied by brushing, spraying or dipping, using zinc of 95 per cent. purity in the dried form. It is stated to give a coating similar to galvanizing. In foundrywork it is interesting to note the claim that the coating will withstand heating up to 200 deg. C. Unless polished, applications have a dreadnought-grey colour. The covering capacity is about 22 sq. ft. to the lb. when brushed on, giving a 0.002-in. thickness of zinc coating. With "spring cleaning" in mind, this leaflet is worth consulting.

**Castable and Mouldable Refractories.** In leaflet RD 85, Morgan Refractories, Limited, Neston, Wirral, Cheshire, give details of some typical applications and the physical properties of Tri-Mor dense "Guncrete." The economies to be gained by spraying on this refractory are stressed, and the illustrations are alike interesting and practical.

# Notes from the Branches

## Lancashire

At the January meeting of the Lancashire branch of the Institute of British Foundrymen, held at the Midland Hotel, Manchester, Mr. J. F. Bowers—director and general manager of Harvey & Longstaffe, Limited—was the lecturer on the subject of "Epoxy Resins in the Foundry."

Mr. Bowers first reviewed the plastics field from the everyday consumer products known to all to the latest uses of resin-impregnated structures based on glass fibre, following this by a more detailed description of epoxy resins and their curing agents. He went on to describe how these new resins could be used for the manufacture of foundry patterns and the benefits accruing therefrom.

Many interesting samples were available and it was explained how glass-fibre-reinforced patternplates—single or double-sided—could be made direct from existing wood patterns. Mr. Bowers also showed resin pattern equipment which had been used under a sand-slinger, consisting of an aluminium core or, alternatively, a resin-impregnated glass-fibre core, faced with a thickness of approximately $\frac{5}{16}$ in. of resin. The figures of time and material given for these samples emphasized the economic advantage of the process. The samples also showed how worn patterns—providing they were not in too bad a condition—could be reproduced in resin, usually at less cost than re-making wooden equipment.

### Summing-up

The points made in the course of the lecture can best be summed up by quoting the concluding opinions expressed by Mr. Bowers, which were as follow:—

"I want to remove any idea from your mind that epoxy-resin patterns are going to replace completely any of the conventional forms of equipment. There is still nothing so cheap as wood, be it softwood or hardwood, and if this is found satisfactory, resin has nothing to offer. Similarly, there is nothing more efficient than full metal-pattern equipment, and if it can be proved economical to use it, and if you can get a customer or the firm's directors to pay for it, good luck to you, because you are right. It is in those cases where wood equipment is just not good enough to produce castings in the quantity or to the quality required—or where it does not permit one to take full advantage of modern aids to production and where full metal equipment as an alternative would not be an economic proposition—then I claim that this new intermediate course offered by the use of resin is worthy of your full consideration. The economic advantage lies in three directions, *viz.*: (1) The ability to faithfully reproduce a pattern or model without shrinkage; (2) the fact that no further work is necessary on the pattern casting when it is removed from the mould, and (3) resin is a far better and more stable material than timber, and its stripping qualities are excellent."

### Discussion

At the close of the lecture numerous and interesting questions were raised, the answers to which contributed to an informative evening. Some of these are condensed into the following: Resin patterns can be made from old wooden patterns by first preparing a plaster cast and rubbing this down to sizes and finish required; there is little to be gained from spraying moulds for resin patterns with low-melting-point metal, owing to the softness of the sprayed metal; in stripping it was an advantage to use parting media; in ageing tests, resin patterns had shown no deterioration; some properties of resin patterns could be varied by using different curing agents, certain of these gave greater hardness but a tendency to brittleness (conversely, with increased elasticity, hardness was lost); choice of fillers was important—with aluminium, cost became a factor, silica-flour was hard to machine, slate powder was softer and marble-flour softer still. Mr. Bowers explained that the use of a double-sided resin pattern in a cast frame represented a considerable advance on earlier techniques; he said also that expanded metal could be used as an alternative to fibre-glass for reinforcement; pigments could be used to colour resin—in many cases it was a pity to use paint. For fastening resin patterns to plates, Mr. Bowers recommended a thread length four times the screw diameter. On a final cautionary note, he explained that, using some resin hardeners, there was a liability for susceptible persons to contract dermatitis, but recent improvements had greatly mitigated this risk.

## Clean-Air Act Meeting in Sheffield

"There is more coal burned efficiently in ten square miles of Sheffield than in any other ten square miles in the world," asserted Mr. F. A. Martin, a member of the Grand Council of the Federation of British Industries, and immediate past-chairman of the East and West Ridings Regional Council, at a conference in Sheffield, on February 10. He was presiding over the conference called by the FBI to discuss the implementing of the Clean Air Act and the Thermal Insulation (Industrial Buildings) Act, which was attended by some 140 representatives of firms.

A questioner asked if it was "morally right" for the Coal Utilisation Council to urge the public to burn coal in open domestic fires and in this way waste "the country's greatest national asset by burning coal inefficiently and damaging the nation's health by smoke emission." Mr. Martin, however, denied that coal was the country's greatest asset—it was people, he said. He added, "Anything that can preserve the comfort as well as the moral tone of people is to be commended, so it is not certain that the open-fire can be immediately condemned." Mr. W. J. Dickie, FBI technical officer, who was the chief speaker, said that the open-fire produced twice as much smoke for every ton of coal burned, as was produced in the industrial plant. He said the coal-fire burned at only ten to 12 per cent. thermal efficiency and the Coal Utilisation Council ought to advocate the use of coke, and homes should be adapted to its use.

### Wakefield-Dick's New Laboratories

To enable them to cope with the increased volume of research and development work on lubricating oils and allied products, Wakefield-Dick Industrial Oils, Limited, have recently opened a large extension to their laboratories at Hayes, Middlesex, which is equipped with the most up-to-date apparatus for this work. Equipment in the new spectrographic laboratory includes apparatus which analyses the metallic constituents of an oil sample; research in the radio-chemical laboratory is conducted with the aid of radio-active isotopes, and much attention has also been given to the provision of equipment and services for more routine work.

NEWCASTLE-UPON-TYNE Education Committee is considering the setting up of a permanent memorial to the late Sir Claude D. Gibb, chairman of C. A. Parsons & Company, Limited, electrical plant manufacturers. The memorial may be a scholarship in technology or an educational building named after Sir Claude.

# Equipment and Supplies

## Magnesium-dust Extraction Unit

A. E. Griffiths (Smethwick) Limited, Booth Street, Birmingham, 21, are marketing a wet-scrub dust unit (Fig. 1), designed for instalment where operations involving grinding and polishing of magnesium alloys are carried out. Besides having a neat, clean appearance, and compact arrangement, it is claimed to have the following advantages:—(*a*) High-efficiency dust separation; (*b*) spray automatically-induced without pumps or nozzles; (*c*) ease of maintenance; (*d*) convenient form in which the collected materials can be emptied and deposited, and (*e*) hot gases may be handled.

Operators' work cupboards are built in, and, where factory layout permits, the units can be provided for back-to-back arrangement. For processes where excessive dust is generated, a specially-large storage space is provided. Since the fan impeller, and motor rotor, are specially balanced the unit is free from vibration, and does not normally require floor fixing. However, provision is made for holding down should exceptional site conditions make this advisable. Controlled air-flow and precision-machined parts give a noise level well below that normally accepted, but where exceptionally quiet conditions are desirable special equipment is available.

## Portable Bar-shearing Machine

The "Beton" size B.26 ("Ficep") portable bar-shearing machine (Fig. 2), recently made available by Thos. W. Ward, Limited, of Savile Street, Sheffield, 4, is a small, compact and powerful unit, which, it is claimed, will shear mild-steel bars up to 1 in. dia., and, with special blades, mild-steel flats up to 1¼ by ½ in. The drive is from a 1½-h.p. motor by vee belts to the flywheel, which transmits the power through hardened steel machine-cut gears running in oil and totally enclosed within the cast-steel body. A cutting speed of 120 stroke per min. is provided, and the machine is easily manœuvred, weighing only just over 5 cwt. and having a wheel mounting and detachable tow-bar. Five sizes are available, with capacities ranging from 1-in. dia. to 2¾-in. dia. mild-steel rounds. Foundrymen would find such a machine useful for cutting gagger and hanger irons, reinforcement bars, etc.

FIG. 1.—*Magnesium-dust extraction unit marketed by A. E. Griffiths (Smethwick), Limited, of Birmingham.*

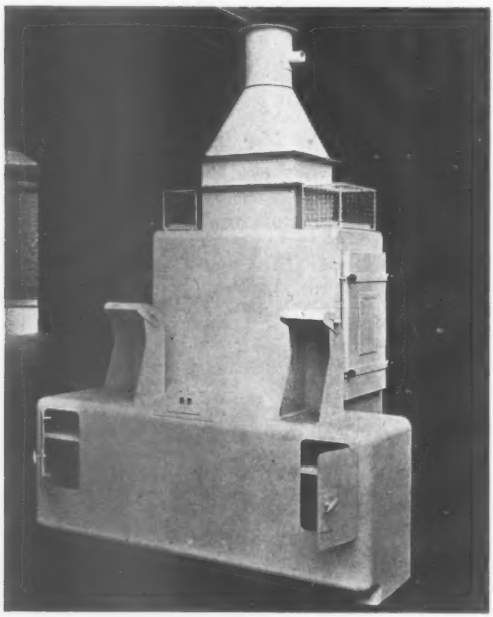

FIG. 2.—*The "Beton" portable bar-shearer, marketed by Thos. W. Ward, of Sheffield.*

## Analogue Computer

Last week, at St. Ermin's Hotel, Westminster, S.W.1, the Ease analogue computer (Model 1100) was demonstrated to the technical press. The computer is designed to assist in the study of complex engineering problems, and enquiries about it should be sent to Winston Electronics, Limited, of Shepperton, Middlesex.

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WESSEX INDUSTRIES (POOLE), LIMITED, Dolphin Works, West Street, Poole, Dorset, are now marketing a new "Wrigley" industrial electric tug (model E.733.). It is capable of hauling a load of four tons on a four-wheel trailer.

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## Death of Dr. Ballay

As briefly announced in last week's JOURNAL, Dr. Marcel Ballay, president and managing director of the *Centre d'Information du Nickel*, Paris, died on February 2 after a short illness. Born in 1896, Marcel Ballay entered early upon a career in metallurgy in the laboratory of the de Dion plant of which he was subsequently appointed head in 1925. In 1928, the year that he joined the *Centre*, he received his diploma as Doctor of Physical Sciences. In 1935 he was promoted to the rank of *Chevalier de la Légion d'Honneur* in recognition of his qualities as a technical professor and, in 1955, the rosette of *Officier de la Légion d'Honneur* was conferred upon him in recognition of his services to industry and to the teaching profession. He was a member of many societies in France and Great Britain. Dr. Ballay was interested in many aspects of metallurgy and there are few fields in this branch of science to which he has not contributed both in research and in teaching.

# House Organs

**The Steel Casting, No. 54.** Issued by F. H. Lloyd & Company, Limited; Lloyds (Burton) Limited and the Parker Foundry (1929), Limited.

This house magazine is now amongst the most elaborate which is produced for internal interest. Quite a few house organs which are meant for customers and overseas agents are equally well presented but they enter the category of advertising. This present one is of larger format than the general run of such publications, but if its objective is to make the staff aware that everything the firm turns out must be of the best possible quality, then, by precept and example, it must certainly go a long way to achieving this end. Apart from dealing with the several activities of the company, there are articles about the works extensions and two from the firm's American associates—American Brake Shoe Company. It is a publication of which the staff of Lloyds can be very proud.

**Nickel Bulletin, Vol. 31, No. 12.** Issued by the Mond Nickel Company, Limited, Thames House, Millbank, London, S.W.1.

This issue is very valuable on account of the indices included in it, which cover subject-matter, trade names, and authors of articles and Patents referred to in the whole volume.

In another house organ published by the Mond Nickel Company, **Inco-Mond Magazine, No. 8,** excellent use has been made of pictures to illustrate about 20 articles. The range is indeed wide and covers many interesting aspects of activities into which nickel and associated metals enter. Amongst those which appealed to the reviewer were a description of London's new Planetarium; a short biography of Axel F. Cronstedt—the man who discovered nickel in 1751; an account of the "Trial of the Pyx"; and an article about the need for cobalt in the diet of sheep. A number of articles dealing with technical subjects are also included.

**Electrified Production. Vol. I. No. 1.** Issued quarterly by the Electrical Development Association, 2, Savoy Hill, London, W.C.2.

The first issue of this new quarterly newsletter is prefaced by a message from Lord Chandos, in which he says, "There is no single industrial concern, whether large or small, which has all the 'know-how' of electrification, and there is no other publication in this country devoted solely to industrial electrification. This modest newletter does not aspire to fill the gap completely but, within its bounds, it hopes at least to suggest new—electrical—solutions to production problems; to indicate the sources of further information. Above all it hopes, by putting forward ideas, to stimulate other ideas and to earn the right to be read even by those whose spare time is small."

**Steel Horizons, Vol. 21, No. 1.** Published by the Allegheny Ludlum Steel Corporation, Pittsburg, Pa., USA.

This house organ is prepared purely for external circulation—thus there are no notes about the company's baseball team! Actually, it is excellent publicity for stainless steel in general and the application of the firm's own make in particular. In the production of the magazine, colour printing is used to great advantage on paper of excellent quality. The first article deals with a general description of the US Navy's sixth nuclear-powered submarine and its launching. Other articles cover toy-manufacture; barrels; weighing machines; spray-gun application of the metal, and other uses of stainless steel.

**Carron Cupola, Vol. X, No. 1.** The house organ of the Carron Company, Falkirk, Scotland.

This is a special issue as it commemorates the 200th anniversary of the starting of the company. Mr. E. J. Leaver, the manager of the Carron Company, in a foreword, stresses the need for the realization by the staff that no concern can live for long on its reputation, and that serious efforts have been and are being made to keep the firm to the forefront of modern developments. The appointments of Mr. G. N. McLachlan as London warehouse manager; Mr. C. S. Holton as welfare supervisor, and Mr. H. Matheson as buyer are announced in this issue.

**S. & W. Magazine, Vol. 11, No. 1.** Issued by Smith & Wellstood, Limited, Bonnybridge, Scotland.

A remarkable service record is publicized in this issue, when dealing with the retirement of Mr. Allan Hannah, a moulder by trade, who joined the firm in 1902 on his 14th birthday. With the exception of a period with the Forces during the first world war, he followed his trade until 1946, when he became the company's gatekeeper. Now at the age of 80, he has entered into a well-earned retirement.

**Craven Machine-tool Gazette, Vol. XIX, No. 3.** Published by Craven Brothers (Manchester), Limited, Vauxhall Works, Reddish, Stockport.

This magazine is addressed primarily to users of the company's products and only a minimum of information as to social activities amongst the staff has ever been included. In the future, owing to a change in the overall publicity policy of the firm, production of the magazine is to be discontinued.

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# Publications Received

**Statistiques de Base de Douze Pays Européens** (Basic Statistics of a dozen European Countries—comparison with the USA and Russia) (in French). Published from the Publicity Department of the European Community, Luxembourg.

The reviewer found himself quite interested in finding out how this country compares with others in the production of livestock, babies, steel, old people, and a mass of other important figures. It was sad to learn that Britain is not doing too well from the productivity point of view and it is to be hoped that the basic formulæ used are incorrect.

**Freight Transport.** Published by the British Transport Commission, Marylebone Road, London, N.W.

This interesting brochure describes and illustrates the very wide variety of rail and road transport facilities now available. Amongst the more interesting pictures is one of a 185-ton steel casting being hauled by British Road Services. The brochure well illustrates how the railways co-operate for the movement of palletized goods.

**Bending Aluminium.** Published by the Aluminium Development Association, 33, Grosvenor Gardens, London, W.1; price 2s.

Obviously this booklet covers wrought material only, but for those whose work embraces the handling of aluminium sheet, strip and tubes, it is a really valuable publication. Practical data are included and the clear illustrations add to their value.

# Company News

**Kitchen & Wade, Limited**

Subject to the company retaining its independence, Kitchen & Wade, Limited, makers of drilling, boring, and honing machines, of Halifax, proposes to declare a fourth interim dividend of 4d. per 4s. share, on or before March 30. This is an increase of 1d. per share on the recently forecast fourth interim and will make a total of 1s. 1d. per share in respect of the year to March 31, 1959. The question of a final dividend will also be considered when the accounts for the year are available.

The proposals, outlined in a letter to holders urging them to reject the amended offer by Asquith Machine Tool Corporation, Limited, of five Asquith ordinary, after the proposed one-for-one scrip issue, and 5s. cash for every four Kitchen & Wade ordinary, put the company's shares on a higher income basis than would be obtained by accepting the Asquith offer.

The deputy chairman of Kitchen & Wade, Mr. D. W. Walker, points out that the company's affairs continue to prosper and having regard to the number of orders recently received and the contracts at present being negotiated, the directors feel they can face the future "with every confidence." The board is in negotiation with an overseas company for the manufacture under licence abroad of some of the company's products and have certain other projects under consideration conditional upon the company retaining its independence.

Asquith Machine Tool Corporation has decided to extend its offer until to-morrow (Friday).

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NOBLE & LUND, LIMITED, machine-tool makers and ironfounders, of Felling-on-Tyne, Gateshead—The dividend is being effectively raised by 1 per cent. to 11 per cent. with a final of 7 per cent. on the £380,600 ordinary capital as doubled by a scrip issue. Group net profit amounted to £65,163 (£65,980) after tax of £75,278 (£67,449).

BRUCE PEEBLES & COMPANY, LIMITED, manufacturing electrical engineers, of Edinburgh—A two-for-one scrip is proposed and also the splitting of the £1 ordinary into 10s. units. These proposals, the directors state, do not indicate any intention of increasing the amount to be distributed as dividend. An extra-ordinary meeting has been called for April 3.

JOHN BOLDING & SONS, LIMITED, brassfounders, engineers, etc., of London, W.1—A final dividend of 9½ per cent. makes 12 per cent. for 1958 on a capital doubled by a scrip issue, representing an increase of 2 per cent. over the previous year's payment. Combined trading profits expanded from £86,359 to £109,247 and the net profit from £40,559 to £49,397.

JOHN SUMMERS & SONS, LIMITED, steelmakers, of Shotton (Ches)—In reply to a shareholder at the annual meeting who suggested that the time had come when the board might consider the possibility of a scrip issue, the chairman, Mr. R. F. Summers, said that if shareholders were patient for a little while they might find that the directors were thinking along those lines.

BRITISH INSULATED CALLENDER'S CABLES, LIMITED—The offers to acquire the whole of the preference and ordinary capital of the Telegraph Construction & Maintenance Company, Limited, have, up to date, been accepted by more than 96 per cent. of the preference holders and 94 per cent. of the ordinary shareholders. The offers are now unconditional. Acceptances from the remaining shareholders of Telcon will be received until further notice.

WAGON FINANCE CORPORATION, LIMITED—Higher profits and an increase in the total dividend on the £1,250,000 one-class capital from 2s. 1½d. to 3s. 6d. per £1 share for 1958 are announced. Following the increase in the interim from 7½d. to 1s. per share, the final is being raised to 2s. 6d. (1s. 6d.). Group profit, before tax, expanded to £533,948 (£414,931) and revenue reserves and undistributed profits are increased to £795,447 (£676,274).

POWER-GAS CORPORATION, LIMITED—In addition to maintaining the dividend at 15 per cent. for the year to September 30, 1958, with an unchanged final of 10 per cent., the company is paying a special interim of 5 per cent. in respect of 1958-59. Group trading profit and other income advanced from £1,052,562 to £1,380,186, and the net profit is up from £358,695 to £534,601. Orders booked during the year totalled £9,250,000, compared with £12,300,000 in the previous year.

INTERNATIONAL COMBUSTION (HOLDINGS), LIMITED—With the final dividend of 17½ per cent. to make 25 per cent. for the year ended September 30, 1958, a special interim dividend is declared of 5 per cent. on account of the current financial year. Group net profits increased from £1,274,745 to £1,371,472 after UK tax of £1,714,255 (£1,526,456). A sum of £3,820 (nil) has been charged in connection with the acquisition of shares in the Clayton Equipment Company, Limited, Hatton (Derbyshire).

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# Board Changes

RENOLD CHAINS, LIMITED—Mr. C. T. Bayliss has been appointed a director.

JOHN THOMPSON WATER TUBE BOILERS, LIMITED—Mr. C. R. Jones and Mr. P. K. Richards have been appointed directors.

BRITISH THERMOSTAT COMPANY, LIMITED—Mr. S. H. Parker has resigned from the board to take up duties as the managing director of a subsidiary.

SUBMARINE CABLES, LIMITED—Mr. F. W. H. Shaw has been appointed deputy managing director of the company, which is owned jointly by Siemens Edison Swan, Limited, and the Telegraph Construction & Maintenance Company, Limited. Mr. Shaw was formerly assistant engineering director of Siemens Edison Swan.

TANGYES, LIMITED—Sir Basil Tangye, who suffered serious injuries in a recent motor accident, is vacating his offices of chairman and managing director. He will remain a director and continue to serve on the committees and councils of a number of trade associations. The appointment of a new managing director is under review. Lt.-Col. R. C. T. Tangye is temporarily acting as chairman and Mr. C. G. Tangye will be acting as managing director.

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# Recent Wills

DODDS, A. S., a director and London manager of John Thompson Water Tube Boilers, Limited, Wolverhampton ... ... ... ... ... ... ... ... £9,951

GOLDING, TOM, a director of W. H. Allen Sons & Company, Limited, mechanical, hydraulic, and electrical engineers, of Bedford ... ... ... ... £34,741

FORSLING, B. E. G., late manager of the gas turbine engineering department of the British Thomson-Houston Company, Limited, Rugby ... ... ... £9,917

PICKERING, E. G., a joint managing director of Johnson, Matthey & Company, Limited, precious metal smelters and refiners, etc., of London, E.C.1 £14,289

BROOM, H. S., founder chairman and joint managing director of Broom & Wade, Limited, manufacturers of air compressors, rock drills, etc., of High Wycombe (Bucks) ... ... ... ... ... £39,835

DUNSTON, RICHARD, chairman of Richd. Dunston, Limited, ship builders and repairers, of Thorne, near Doncaster, and of Henry Scarr, Limited, shipbuilders, of Hessle (Yorks) ... ... ... £105,749

# News in Brief

BARCLAY, EMPSALL & COMPANY, LIMITED, non-ferrous refiners, Barkerend Foundry, Pit Lane, Bradford, are moving to a new address in Henry Street, Little Horton Lane, Bradford.

THE DESIGN DEPARTMENT of Marshall Sons & Company, Limited, engineers, Gainsborough, is working on a new project—a large-wheeled tractor—for the Ministry of Supply.

THE BRITISH STANDARDS INSTITUTION is building new premises at Hemel Hempstead to cater *inter alia* for the testing facilities needed under the control of certification marking.

CONTRACTS to the value of nearly £110,000 have been placed by the Ulster Transport Authority with the Leyland group of companies for the supply of 68 goods vehicle chassis.

TO MEET INCREASED DEMAND for Dohmfrac precoated-resin sand for shell moulding and shell-core production, a third manufacturing plant is now in full production at the Burslem, Stoke-on-Trent, works of Mellor Mineral Mills—one of the Dohm group of companies.

IN ADDITION to the previously announced programme (JOURNAL, January 8, 1959) for the course on Cupola Melting to be held at Birmingham University from March 23 to 25, Dr. F. Neumann will read a paper on "Some Cupola Research at the *Giesserei Institut* at Aachen."

HOLLAND FOUNDRY, LIMITED, 155/159, Clapham Road, London, S.W.9, will cease to trade after February 21. The works is not to be continued as a foundry, the premises having been sold to the Carter group of companies and the foundry company will go into liquidation.

THE Y.T.C. UNIVERSAL, LIMITED, of 62, Hope Street, Liverpool—a non-profit-making concern—was launched on February 9 by the Hon. David Bowes Lyon. Its objective is to help industrial concerns to organize visits by groups of their apprentices and work-people, to works overseas.

Mr. ERIC MENSFORTH, chairman of Firth Brown Tools, Limited, Speedicut Works, Sheffield, when presenting the prizes at the annual speech day of Sheffield Central Technical School on February 5, told students that with Britain at the centre of technical matters, the future for them was a challenge.

DEXION, LIMITED, Maygrove Road, Kilburn, N.W.6, announce that C. W. F. Hamilton & Company, Limited, of Middleton, Christchurch, have installed plant to produce up to 2,000,000 ft. of slotted angles per year. New Zealand now becomes the fourteenth overseas country to manufacture Dexion slotted angle.

THE INSTITUTE OF PERSONNEL MANAGEMENT, 80, Fetter Lane, London, E.C.4, announces a non-residential course in wage structure, policy and administration to be held at Ashley Court Hotel, Queen's Gate, London, S.W.7, from March 9 to 13. The fee is £15 15s. which includes lunch, morning coffee, afternoon tea and gratuities.

MORE THAN 50 MEN who were given notice at Beardmore's Parkhead Forge, Glasgow, two weeks ago because of redundancy will now keep their jobs. They are men in the 67 to 69 age group. Little or no overtime is being worked by men at Parkhead Forge and the overtime position is under consideration by shop stewards.

LAST WEEK, the first Australian-built Mercedes-Benz car left the production line at Port Melbourne. The car, a 220 saloon model, is the first of its type containing Australian parts. The Australian content will be progressively increased in Mercedes-Benz vehicles, until it reaches 50 per cent. for cars, and 90 per cent. for commercial vehicles.

THE SUCCESSFUL STUDENTS taking the courses in foundry practice at Borough Polytechnic, London, S.E.11, last Friday received their prizes from Mr. V. C. Faulkner. The ceremony was presided over by Mr. Hubert A. Secretan, C.B.E., M.A., and was attended by the principal, Dr. J. E. Garside, and a number ot directors of London foundry concerns.

Mr. D. W. N. PITTS, assistant technical adviser on iron and steel processes to British Oxygen Gases, Limited, addressed the Sheffield Metallurgical Association headquarters in Sheffield, on February 10. He spoke on "Refractories and the Oxygen Steelmaking Processes," and said that the future of oxygen steelmaking in this country depended very much on the economic health of the world.

ABOUT 120 PEOPLE attended the first of three lectures on domestic oil-fired central-heating given on February 9 at Nottingham Technical College, by Mr. D. J. Thomas, project engineer for central-heating equipment manufacturers. The series is organized in conjunction with the Master Plumbers' Association, and is designed to provide both consumers and plumbers with practical information on central-heating by oil.

INCREASE IN THE DEMAND for the sintered metal products of the Morgan Crucible Company, Limited, has led to a move to larger premises. The sales office has been moved to Wandsworth Works, Point Pleasant, Wandsworth, London, S.W.18, and a new factory and laboratory, established there for the production and development of Sinterlink. This combines plant and facilities previously situated at Battersea, and Norton, Worcester.

A CASTING on a lorry stopped by the police in Shoreham Street, Sheffield, was found to be 1 ton 16 cwts. 3 qrs. above the permitted weight, it was stated in Sheffield on February 13. The owner, Mr. Albert Edward Marriott, haulage contractor, Cross Addy Street and Walkley Road, Sheffield, and the driver, Mr. Leslie Damms, of Orchard Road, Sheffield, pleaded "guilty" to using a lorry which was overloaded. Marriott was fined £10 and Damms £2.

SPEAKING ON FEBRUARY 12 at a Press visit arranged to demonstrate the prototype of Explorer, the diesel-electric locomotive developed by B.T.-H. and Lister Blackstone Rail Traction, Limited, Mr. W. B. G. Collis, manager of the British Thomson-Houston Company, Limited, traction department at Rugby, said that orders received by his department in the first six weeks of this year had been brought up to more than £4,000,000 by the London Transport order for equipment for the Central Line.

THE AEU HAS COMPLAINED to the management of Firth Brown Tools, Limited, Sheffield, that apprentices there have been instructed to attend a series of lectures arranged by the Economic League, and suggests that these are outside the normal training plan. The management has told shop stewards that the lectures are non-political, as is the Economic League. The union district committee has asked that, in future, lectures should be given by speakers acceptable to both sides on trade questions and practices.

IN FURTHERANCE OF ITS PLAN to replace electric trolleybuses with diesel buses, London Transport Executive has signed a contract with George Cohen's for the disposal of practically the whole of its fleet of

*News in Brief*

trolleybuses. Some 1,400 are involved. The conversion will take about three years, commencing in March, when three South London routes (696, 698 and 654) will be withdrawn and replaced by diesel-bus routes. Disposal of the trolleybuses themselves is, however, likely to begin within the next few days.

SIR STUART GOODWIN (chairman of Jones & Colver (Novo), Limited, and other companies) has given an additional £5,000 to the Goodwin Charity of the Cutlers' Company, making the total capital £50,000. The charity replaced the Thomas Hanbey Charity in 1956, when its money reverted to Christ's Hospital because it was found the conditions were no longer being met. The trust provided £2 and a luncheon annually for the elderly and infirm. In 1956, Sir Stuart and Lady Goodwin gave the Cutlers' Company £15,000 for the new trust and added further gifts of £10,000 in 1957, and £20,000 in 1958.

ARRANGEMENTS ARE NOW IN HAND for the next Mechanical Handling Exhibition and Materials Handling Convention, to be held at Earls Court, London, from May 3 to 13, 1960. Last year the scope of the exhibition was widened to include international exhibits, and equipment on show came from America, France, Italy, Germany and Scandinavian countries. The 1960 display will cover the most up-to-date equipment for saving time and cost and for ending labour in practically every industry. Full details of the exhibition can be obtained from the organizer, Mr. H. A. Collman, Mechanical Handling Exhibition, Dorset House, Stamford Street, S.E.1.

Mr. JOHN BROOKS, 19-year-old "top apprentice" in a competition run by the Australian Junior Chamber of Commerce, arrived in Sheffield last week for a six-weeks' visit during which he will work for Sheffield firms. He is an apprentice motor-fitter with the South Australian Railways and in all will stay in Britain for a year, as guest of the British Junior Chamber of Commerce, to study British engineering and way of life. His wage in Australia was £A12, but whilst in Britain he will be paid the British apprentice's £6 or so. Amongst the firms he will work for in Sheffield are Laycock Engineering, Limited, James Neill & Company (Sheffield), Limited, Samuel Osborn & Company, Limited, and Cravens, Limited, of Darnall. For the first week he was the guest of Mr. Edgar Denton, managing director of Denton Steel and Tool Company, Limited.

JAGUAR CARS, LIMITED, Coventry, announced on February 12 that negotiations had been completed to buy the premises of the Brown's Lane factory which has been leased from the Ministry of Supply since 1951. No price was divulged. The factory and ancillary buildings with adjacent land covering an area of 80 acres, was one of three large shadow factories built during the war in Coventry by the Ministry. A spokesman for the Jaguar company said that the purchase did not mean any immediate expansion of the factory, but provided for the acquisition of additional administration blocks now occupied as a research and development centre on behalf of the Ministry by the General Electric Company. Because of the sale, the GEC has been asked by the Ministry to transfer the work of its engineering group to its existing production site at Portsmouth. About 800 employees would be affected, and the Jaguar company has offered to consider employing persons who may be displaced by the move.

ABOUT 680 MEN went on strike on Tuesday, February 10, at the Nuneaton works of Sterling Metals, Limited—part of the Birmid Industries group—in support of some men who had refused to work beside Indians transferred from the company's Coventry factory. There had been a stoppage on Monday, but a resumption of work was made on Tuesday morning to permit negotiations. They broke down because, according to a management spokesman, the men demanded that the company should remove the Indians from the core-block machines. The firm has offered to continue negotiations when all the men return to work. A spokesman for the company said the Indian workers in question, had been in the company's employment since 1950, and had constantly operated similar machines at the company's Coventry works for years, working alongside English workers. They had recently been transferred to the Nuneaton works. The company, in common with the trade unions, did not recognize any colour bar.

## Obituary

Dr. PERCIVAL THOMAS CARTER, senior lecturer in metallurgy at the Royal College of Science and Technology, Glasgow, was killed on February 1 while descending a snow ridge on Stob Coire an Lochan, Glencoe. He fell 500 ft. as he tried to save a colleague who was also killed. Dr. Carter joined the staff of the College soon after graduating at King's College, Durham, just before the war.

The American Press reports the death, at the age of 91, of Mr. VERNE E. MINICH, the inventor of the Wheelabrator shotblast machine. He was the first president of the American Foundry Equipment Manufacturers' Association, serving from 1919 to 1921, and was a director of the American Foundrymen's Society from 1916 to 1921. He visited this country on several occasions, the last being about 1930 when he made arrangements for the manufacture of his machines in this country. He was a founder of the Sand Mixing Machine Company in 1908 which later became the Wheelabrator Corporation, of Mishawaka, Indiana, of which firm he became chairman in 1941 and honorary chairman in 1957.

Dr. GEORGE LAWTON, principal of the Sheffield College of Commerce and Technology since 1947, died suddenly on February 12 at the age of 59. Dr. Lawton held the degree of B.SC.(HONS.) in chemistry and gained the PH.D. for research on the carburization of iron and steel. He was a fellow of the Royal Institute of Chemistry and an Associate of the Institute of Chemical Engineers. From 1928 to 1931 he had been head of the metallurgical research department of the International Telephone and Telegraph Corporation at Hendon. Dr. Lawton had also been a member of the City and Guilds advisory committees, the City and Guilds exploratory committee on fuel technology, and the Association of Principal Teachers committees on adult education and national certificates in chemistry.

The death took place on February 9, of Sir DIGBY LAWSON, for many years chairman of Fairbairn Lawson Combe Barbour, Limited, textile-machinery manufacturers, of Leeds, and elder son of the first baronet, Sir Arthur Lawson, who was also chairman of the company for many years. Sir Digby was 78. He joined his father in the family concern early in the century and later became associated with Urquhart Lindsay & Robertson Orchar, Limited, engineers and gear cutters, of Dundee, of which he also became chairman. Sir Digby had a distinguished Army career for nearly 20 years before taking up his commercial interests in 1930. Owing to ill-health he resigned his chairmanships in 1955, but he remained a director of both companies until his death.

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# Personal

## RETIREMENT OF MR. R. W. P. HOLT

An association with the Widnes Foundry & Engineering Company, Limited, lasting for well over 30 years, has ended with the retirement recently of Mr. R. W. P. Holt. He joined the board of the company in 1925 when it traded under the name of Widnes Foundry (1925), Limited.

MR. R. W. P. HOLT

Mr. Holt continued as a director when the company was taken over by Thos. W. Ward, Limited, Sheffield, in 1936 and its name was changed to Widnes Foundry & Engineering. The occasion of his retirement was marked by a presentation to him of a gold wristlet-watch by Mr. Arnold Carr, chairman of the company. Mr. W. Salisbury also received a gift, this being presented by Mr. R. Credland.

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Mr. P. D. M. AIRD has been appointed chairman of Glover & Main, Limited.

Mr. GEORGE TAYLOR and Mr. JOHN D. ECCLES have been appointed directors of Head Wrightson Steel Foundries, Limited.

Mr. JAMES HODGE, who was chief engineer of Power Jets (Research and Development), Limited, has been appointed to the newly-created post of chief engineer of the Holman group of companies.

Mr. L. HOLMES, who began as a machine moulder in the iron foundry of Thomas Marshall & Son, Limited, Gainsborough, has retired after more than 50 years' service with the company.

Mr. J. HILES, head of the department of science at Sheffield College of Commerce and Technology, has been appointed acting principal of the college, following the death of Dr. GEORGE LAWTON.

Mr. W. H. HIGGINBOTHAM, chairman of Edgar Allen & Company, Limited, Sheffield, presented the prizes at the first "speech-day" of the Brook secondary school, Stardbroke, Sheffield, on February 13.

Mr. G. R. BELL has been appointed general manager of the British division of Wall Colmonoy (Canada), Limited, Motherwell, Lancashire. He will be responsible for the company's entire European operations.

Mr. JOHN A. D. LAWSON, who succeeds to the baronetcy held by his father, the late Sir Digby Lawson, is sales director of Fairbairn Lawson Combe Barbour, Limited, Wellington Foundry, Leeds, of which his father was formerly chairman.

Mr. A. J. WORSTER has been appointed a director of the Rover Company, Limited, responsible for production. He has been manager of the company's Tyseley group of factories since 1932, and was appointed executive director (production—Tyseley) in 1957.

Mr. GEO. E. WELLS who for the last 14 years has been manager of the Holland Foundry, Limited, is now that the foundry is shutting down, retiring. This will complete 54 years in the foundry industry as he was with the late Rodney Foundry Company, Limited, for 41 years.

After nearly 47 years' service with the British Thomson-Houston Company, Limited, Mr. C. H. CHAPLAIN, manager of the publicity department, has retired. He is succeeded by Mr. H. G. HARLOW, who has been manager of the BTH Newcastle district office since May, 1955.

Mr. M. R. BONAVIA, formerly principal officer (modernization) in the general manager's office, Eastern Region, British Railways, has been appointed director of studies at the British Transport Commission Staff College, Woking. The objective of this new College is to provide advanced training for younger officers in all the Commission's services.

Mr. L. K. EVERITT and Mr. W. J. MCBRIDE, directors of Edgar Allen & Company, Limited, are visiting South Africa and Rhodesia. Mr. McBride will later attend the opening in Iran, by the Shah of Persia, of the new cement factory, equipment for which has largely been supplied by the company, and which is due to begin work at the end of March.

Mr. S. A. A. KNOTT, who for 18 years has been secretary of Charles Roberts & Company, Limited, railway-wagon builders, Horbury, near Wakefield, has resigned that position on his appointment as managing director of S. J. Claye, Limited, the company's industrial banking subsidiary. He retains his directorship of Charles Roberts. Mr. L. BARRON, assistant secretary since 1943, has been appointed secretary to succeed Mr. Knott.

Sir PETER ROBERTS, M.P. for the Heeley division of Sheffield, has been elected to the board of the Staveley Coal and Iron Company, Limited, a holding company. Sir Peter is chairman of Newton, Chambers & Company, Limited, deputy chairman of its subsidiary, Ransomes & Rapier, Limited, and chairman of the Wellman Smith Owen Engineering Corporation. He is also a director of several other companies.

Dr. N. A. DUDLEY, Reader in engineering production and head of the Department of Engineering Production at Birmingham University, has been appointed to the Chair of engineering production at the University. Earlier in his career Dr. Dudley was a production engineer in industry and at one time senior lecturer in the department of engineering production at the Wolverhampton and Staffordshire Technical College. Dr. W. T. ROBERTS has been appointed Lecturer in Industrial Metallurgy at Birmingham University.

Mr. H. W. KIRKBY has been appointed a director of Thos. Firth & John Brown, Limited. He joined the company in 1932, and was appointed a director of its subsidiary, the Firth-Derihon Stampings, Limited, in 1952, and a deputy manager of the Brown Firth Research Laboratories in 1956. He is also a director of Firth-Vickers Stainless Steels, Limited. Mr. J. WOOLMAN has retired as manager of the Brown Firth Research Laboratories and as a local director of Thos. Firth & John Brown after 39 years' service. He has been succeeded in these positions by Dr. F. W. JONES.

Sheepbridge Engineering, Limited, Chesterfield, Derbyshire, announce changes in the management of two of their subsidiary companies. Mr. R. W. T. BRAY has severed his connection with Bray Construction equipment, Limited, Feltham, and Mr. D. J. HARROWELL, formerly technical director, takes over as managing director. Mr. W. J. COLLARD, who was transferred from Bray Construction some years ago to an appointment as director and general manager of Harold Andrews Sheepbridge, Limited, Halesowen, now returns to Feltham as commercial director. He is succeeded at Halesowen by Mr. B. C. GOODWIN, formerly sales manager.

# Cutting costs in the foundry

## *Versatile Yale trucks save labour, cut production time, prevent damage*

**In British foundries, Yale trucks help to avoid unnecessary handling, free men for more productive work, cut production time and costs. Here are three examples of Yale *planned handling* at work:**

### PREVENTING DAMAGE...

The versatile Yale Series 51 truck is used in all foundry departments by K & L Steel Founders & Engineers Ltd. of Letchworth. It is seen here transporting 12 carbon electrodes weighing some 3,900 lbs from the foundry stores to the steel melting shop. By placing these brittle electrodes on stillages, and moving them with the Series 51 truck, damage has been virtually eliminated.

**Yale Series 51 electric trucks are available in capacities from 3,000 lbs to 10,000 lbs.**

### SAVING LABOUR...

This Yale Worksaver saves time and labour at the Leeds foundry of Catton & Co. Ltd. Here it is seen loading a full ladle on to a bogie for movement to the moulding shops. The 10-ton bogie is pulled by the Worksaver, driven by the ladle man. Drivers of trucks previously used to haul the ladle have been released for more productive work in the foundry. The Worksaver also helps to speed deliveries of steel to all moulding shops.

**Yale Worksavers are available in Platform and Pallet Models (2 or 3 tons); Fork Lift (1,500, 2,000, 2,500, 3,000 lbs); Tractor (700 lbs draw-bar pull).**

### ...SAVING TIME AND COSTS

At the Holfos foundry of John Holroyd & Co. Ltd., the old practice of searching through a pile of heavy chills to find the right one for a particular job was dispensed with by building a special store. Although this store is only 85' by 25' in area, it accommodates some 5,000 chills. Chills are housed in 370 compartments, on 5-tiered racks. Each is easily identified, and is moved on a pallet by a Yale Warehouser fork truck, which can work in aisles only 6 feet wide. Heavy manhandling no longer adds to time and production costs.

**Yale Warehousers are available in Platform Models (2 tons); Fork Lift Models (2,000 and 3,000 lbs).**

*The Yale range includes power trucks for every lifting and moving need up to 200,000 lbs; Hand Trucks for loads up to 12,000 lbs; Hoists for lifting up to 40 tons (trolleys to suit all models); Pul-Lifts in capacities from ¼ to 15 tons.*

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**The YALE & TOWNE Manufacturing Company, Materials Handling Division, Dept. FT2, Wednesfield, Staffs. Tel: Willenhall 941.**

# Raw Material Markets

## Iron and Steel

Although the number of blast furnaces now in production is still reduced by 13 from those in operation a year ago, pig-iron supplies are plentiful. Most producers are carrying large tonnages in stock and there is little prospect of any early rise in production; in fact, the tendency is for a further cut in outputs.

The steelworks' requirements of basic pig-iron are now much reduced. This has necessitated the closure of some furnaces and has cut outputs from other units, but the steelworks continue to receive adequate supplies and they hold appreciable tonnages in stock. When the time comes for the steelworks to take up additional quantities, there will be no difficulty in stepping up deliveries. With the present tonnages in stock at the furnaces there is still no inclination on the part of the foundries to carry stocks other than those needed to provide for work on hand. This position is accentuated by the uncertainty in demands for castings and the expectancy of a reduction in prices. Producers are trying to clear their current makes either to home or overseas buyers, together with the heavy stocks already held by them, as the present method of working is both uneconomical and costly. Much larger tonnages could be shipped against the many inquiries received if UK prices were more competitive with those of foreign makers, but competition is intense.

There is little change among the foundries. The motor-car industry continues to be comparatively the largest users of castings. Its delivery schedules are maintained at good levels, and this enables the engineering and speciality foundries connected with the industry to obtain fairly good outputs. The machine-tool industry shows no signs as yet of increasing its demand for castings. Overall, however, the foundries producing high-duty castings are much better employed than other sections of the trade.

In the light-castings trade the improvement in demand for castings from the domestic utensil industry is maintained, but a much larger flow of business is required to enable all these foundries to improve on present outputs and also to increase substantially their present demand for high-phosphorus pig-iron. There has been some slight improvement in their consumption of pig-iron, although many of them appear to be using a larger proportion of scrap in their mixture. Both the jobbing and textile foundries are in need of more work.

Foundry coke deliveries are satisfactory. The demand for the better and heavier grades of cast-iron scrap is maintained and arisings are readily accepted.

There is at present little sign of an overall improvement in business at the re-rolling mills. Most of the mills producing small bars and light sections are working short time and rolling programmes can only be arranged on day-to-day arisings of orders. Home orders are spasmodic and, with the lower prices quoted by producers abroad, export business is small. Plentiful supplies of billets are available from home steelworks and nothing near the tonnages on offer are being taken up.

## Non-ferrous Metals

Copper was quietly steady last week and the price showed a total gain of over £5 a ton on the previous week, thus recovering a little over 60 per cent. of its recent fall. In some ways this was only to be expected as the decrease had not been soundly based. The upswing was accelerated by the US Government's decision to restrict exports of copper to the Soviet block. The lower London prices ruling have, however, made their mark and the Belgian price has been reduced to the equivalent of approximately 29½ cents per pound, New York or Antwerp. In the US the custom smelters on Monday raised their price by ½ cent to 30.50 cents a pound, delivered Connecticut Valley. Business is reported as satisfactory. The export price, f.a.s. New York, was quoted on Tuesday at 30.50 cents per pound against 30.00 cents previously.

Fluctuations in the copper price are worrying Continental consumers and the International Wrought Nonferrous Metals Council issued a communiqué from Paris towards the end of last week saying that it has decided to take steps towards ensuring more stable copper prices. The main point raised is the recommendation that statistics should be made available from the metal fabricators to the producers to include the trend of orders booked, monthly copper consumption, and studies on substitutes. All this would help, it is hoped, in improving the flexibility of copper production and thus bring about a greater degree of price stability.

The slowing down in the pace of economic recovery in the US has raised a small doubt as to the outlook in the months ahead. But assuming the better trend continues, prospects for the copper price remaining at least at its present level are good.

Tin has been under restraining influences. Firstly, it would appear that the buffer stock manager has been selling relatively small tonnages from stocks and, secondly, the fear that the International Tin Council, at its meeting in London this week, would raise the quota for the second quarter of this year. Since October, 1958, quarterly quotas have been limited to 20,000 tons, equivalent to a cut of 48 per cent. on exports during the base year ended September 30, 1957.

The present position is healthy with demand satisfactory, little tonnage available, and stocks in consumers' hands very low. Indeed there seems to be no great obstacle in the way of the price advancing to over £780 a ton, the level at which the buffer stock manager can sell from stocks to the market.

Lead, even after its price cut last week in America to 11½ cents a pound, remains weak and featureless on both sides of the Atlantic. Demand is not improving in the US and with the prospect of some of the metal shut out by the import quotas coming back on to the London market the UK price is vulnerable. US production of recoverable lead in 1958 was the lowest this century at 228,000 tons and was 21 per cent. below the 1957 figure. Even so this is too large relative to consumption plus the tonnage of lead coming into the States in semi-manufactures form which escapes the import tariff. The US price is equivalent to £92 a ton, compared with about £70 a ton quoted on the London Metal Exchange.

Zinc is a reasonably steady, though quiet and featureless, market in London. The same comment applies to the US market where the price is 11½ cents a pound. The outlook is not good because imports of metal shut out from the market by the quotas may soon find its way back to the LME. Moreover, US stocks are still increasing and a further cut in the price cannot be ruled out. The present North American position with regard to lead and zinc is reflected by the news item that Canada and the United States will try to hold an international conference concerned with the two metals.

One encouraging feature in the US picture is that steel production is expected to continue its upward trend in front of the wage negotiations coming up for discussion this summer.

## Baker Perkins Machinery at work . . . . . *at Peter Brotherhood Ltd.*

Peter Brotherhood Ltd. use this 'Cadet' Rotary Table Shot Blast Machine for a wide range of application at a high production rate. Note especially the control desk which includes signal lights, 24 volt current socket for inspection and ammeters indicating the shot output of the impeller. The wiring circuit is arranged for automatic operation to cut out human errors.

*Please write for further details to:*

BAKER PERKINS
*Foundry Machinery Division*
PETERBOROUGH · HEBBURN ON TYNE · ENGLAND

BP/F2

**HISTORICAL NOTE**

*Peter Brotherhood Ltd. were established in London in 1868. In 1907, the works was transferred to Peterborough, Northants. In their Foundry, they produce a wide range of general engineering castings for air and gas compressors, steam turbines, steam engines, refrigeration plant, water turbines, chemical filtration plants, textile machinery, brewery machinery, and many other applications*

# Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

February 18, 1959

## PIG-IRON

**Foundry Iron.**—No. 3 IRON, CLASS 2: Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

**Low-phosphorus Iron.**—Over 0.10 to 0.75 per cent. P, £23 17s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £24 1s. 3d.

**Scotch Iron.**—No. 3 foundry, £25 3s. 6d., d/d Grangemouth.

**Cylinder and Refined Irons.**—North Zone, £25 19s. 0d.; South Zone, £26 1s. 6d.

**Refined Malleable.**—P, 0.10 per cent. max.; North Zone, £27 6s. 6d.; South Zone, £27 9s. 0d.

**Hematite.**—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.: N.-E. of England (local iron), £25 6s. 6d.; Scotland (Scotch iron), Zone S.1, £25 13s. 0d.; Sheffield, £26 15s. 0d.; Birmingham, £27 4s. 0d.; Wales (Welsh iron), £25 6s. 6d.

**Basic Pig-iron.**—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leics.

## FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

**Ferro-silicon** (6-ton lots and over).—45 per cent. Si, £41 0s. 0d. to £43 10s. 0d., scale 15s. 0d. per unit; 75 per cent. Si, £56 10s. 0d. to £60 10s. 0d., scale 15s. 0d. to 16s. 0d. per unit.

**Ferro-vanadium.**—50/60 per cent., 22s. 6d. per lb. of V.

**Ferro-molybdenum.**—65/70 per cent., carbon-free, 12s. 10d. per lb. of Mo.

**Ferro-titanium.**—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £287 0s. 0d.

**Ferro-tungsten.**—80/85 per cent., 7s. 11d. per lb. of W.

**Tungsten Metal Powder.**—98/99 per cent., 10s. 11d. per lb. of W.

**Ferro-chrome** (6-ton lots and over).—4/6 per cent. C, £77 0s. 0d. to £81 0s. 0d., basis 60 per cent. Cr, scale 26s. 0d. to 27s. 6d. per unit; over 6 per cent. C, £74 10s. 0d. to £77 10s. 0d., basis 60 per cent. Cr, scale 26s. 0d. to 27s. 6d. per unit; 2 per cent. C,* 1s. 7½d. to 1s. 10½d. per lb. Cr; 1 per cent. C,* 1s. 8d. to 1s. 11d. per lb. Cr; 0.15 per cent. C,* 1s. 9d. to 2s. 0d. per lb. Cr; 0.10 per cent. C,* 1s. 9½d. to 2s. 0½d. per lb. Cr; 0.06 per cent. C,* 1s. 9½d. to 2s. 0½d. per lb. Cr.

**Metallic Chromium.**—98/99 per cent., 6s. 10d. per lb.

**Metallic Manganese.**—94/96 per cent., carbon-free, £255 0s. 0d.; 96/98 per cent., £285 0s. 0d.

**Ferro-columbium.**—65/72 per cent., Cb + Ta, 19s. 9d. per lb., Cb + Ta.

**Ferro-manganese** (home).—78 per cent., £73 0s. 0d.

## SEMI-FINISHED STEEL

**Re-rolling Billets, Blooms, and Slabs.**—BASIC: Soft u.t., £32 15s. 6d.; tested, 0.08 to 0.33 per cent. C, £33 15s. 6d.; hard (0.41 to 0.60 per cent. C), £34 17s. 0d.; silico-manganese, £43 16s. 6d.; free-cutting, £36 14s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £41 1s. 0d.; silico-manganese, £44 4s. 0d.

* Average 68-70 per cent.

**Billets, Blooms, and Slabs for Forging and Stamping.**—Basic, soft, up to 0.33 per cent. C, £38 10s. 0d.; basic hard, over 0.41 up to 0.60 per cent. C, £39 12s. 6d.; acid, up to 0.25 per cent. C, £43 4s. 0d.

## FINISHED STEEL

**Heavy Plates and Sections.**—Ship plates (N.-E. Coast), £42 2s. 0d.; boiler plates (N.-E. Coast), £44 12s. 0d.; floor plates (N.-E. Coast), £43 11s. 0d.; angles (N.-E. Coast), £39 16s. 6d.; joists (N.-E. Coast), £39 12s. 6d.

**Small Bars, Sheets, etc.**—Rounds and squares, under 3 in., and flats 5 in. wide and under, untested soft basic, 50 tons and over, £40 0s. 6d.; under 10 tons to 4 tons, £40 18s. 0d.; under 4 tons to 2 tons, £41 3s. 0d.; hoop and strip, coils, £39 0s. 0d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £44 16s. 0d.; black sheets (hand mill), 24g., £58 14s. 6d.; galvanized corrugated sheets, 24g., £67 10s. 0d.

**Alloy Steel Bars.**—1 in. dia. and up: Nickel, £68 10s. 0d.; nickel-chrome, £99 11s. 0d.; nickel-chrome-molybdenum, £111 19s. 0d.

## NON-FERROUS METALS

**Copper.**—Cash, £235 15s. 0d. to £236 0s. 0d.; three months, £235 15s. 0d. to £236 0s. 0d.; settlement, £236 0s. 0d.

**Copper Tubes, etc.**—Solid-drawn tubes, 2s. 2½d. per lb.; rods, 250s. 0d. per cwt. basis; 20 s.w.g., 285s. 0d. per cwt.

**Tin.**—Cash, £771 10s. 0d. to £772 0s. 0d.; three months, £772 10s. 0d. to £773 0s 0d.; settlement, £772 0s. 0d.

**Lead (Refined Pig).**—Second half February, £69 10s. 0d. to £69 12s. 6d.; second half May, £70 10s. 0d. to £70 12s. 6d.

**Zinc.**—Second half February, £74 5s. 0d. to £74 7s. 6d.; second half May, £72 0s. 0d. to £72 10s. 0d.

**Zinc Sheets, etc.**—Sheets, 15g. and thicker, all English destinations, £109 0s. 0d.; rolled zinc (boiler plates), all English destinations, £106 15s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £94 0s. 0d.

**Brass Tubes, etc.**—Solid-drawn tubes, 1s. 9¾d. per lb.; sheets to 10 w.g., 194s. 6d. per cwt.; wire, 2s. 7¾d.; rolled metal, 194s. 6d. per cwt.

**Brass (Brazing).**—BS1400, B3 (65/35), £152; B6 (85/15), £204; BS249, —.

**Brass (High Tensile).**—BS1400, HTB1 (30 tons), £189; HTB2 (38 tons), £195; HTB3 (48 tons), £212.

**Gunmetal.**—BS1400, LG2 (85/5/5/5), £187; LG3 (86/7/5/2), £197; G1 (88/10/2/½), £255; (88/10/2/1), £239.

**Phosphor Bronze.**—BS1400, PB1 (AID released), £282 per ton.

**Leaded Phosphor Bronze.**—BS1400, LPB1 (1060), £206 per ton.

**Phosphor Bronze Strip, etc.**—Strip, 285s. 6d. per cwt.; wire, 4s. 0½d. per lb.; rods, 3s. 4d.; tubes, 3s. 4d.; chill cast bars: solids 3s. 3½d.; cored 3s. 4½d. (CHARLES CLIFFORD, LIMITED.)

**Nickel Silver, etc.**—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 9¾d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 2¾d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 1¾d. All prices are net.

**Other Metals.**—Magnesium, ingots, 2s. 3d. per lb. Antimony, English, 99 per cent., £190 0s. 0d. Quicksilver, ex-warehouse, £74 0s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £180 0s. 0d.; aluminium bronze (BS1400), AB1, £226; AB2, £245.